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D • I S C O U R S E S

ON THE

OBJECTS AND USES

OF

SCIENCE AND LITERATURE.

BY

HENRY LORD BROUGHAM, PROF. SEDGWICK, F.R.S.,
AND THE HON. G. C. VERPLANCK.

WITH PRELIMINARY OBSERVATIONS, &c., ON READING,

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ADVERTISEMENT.

THE following Discourses, published at different times in England and in this country, have been collected, as embodying a great amount of useful and interesting matter in regard to Scientific and Literary Studies. The Discourse of Lord Brougham was prepared as an Introduction to the publications of the British Society for the Diffusion of Useful Knowledge, and has passed through many editions both in Europe and in this country. The Discourse of Professor Sedgwick was delivered at the University of Cambridge (England) in 1832, and, though it has passed through *four* editions in that country, and is universally regarded as one of the ablest efforts of its eminent author, is now republished here for the *first* time. The Discourses of Mr. Verplanck are too well known to need commendation.

It is proper to state, that the Discourse of Professor Sedgwick, having been delivered on a day of annual commemoration in Trinity College, contains several local allusions, and an introduction of the same character, which it has been found expe-

dient to omit in the present edition. To render the Discourse complete in itself, as well as to avoid the encumbrance of an Appendix, the publishers have incorporated with the text a considerable amount of matter which is given by the author in the form of Notes. These portions, however, have, for the reader's convenience, been included within brackets, and may, without inconvenience, be omitted in reading. To enable them to adopt this course, and yet preserve the unity of the Discourse, the publishers have also found it necessary to place last in order that topic which, by the author, was placed first, viz., The Study of the Laws of Nature.—With the exceptions thus specified, and the omission of a small part of the author's Appendix, this edition will be found to embrace the whole of this admirable discourse, in the author's own language.

It is also proper to add, that the Note of Professor Potter on the *Advantages of Literature and Moral Science*, was prepared and printed before the introduction of Professor Sedgwick's discourse had been decided on.

New-York, August, 1840.

PRELIMINARY OBSERVATIONS.

ON READING.

“ If I were to pray for a taste which should stand me in stead under every variety of circumstances, and be a source of happiness and cheerfulness through life, and a shield against its ills, however things might go amiss, and the world frown against me, it would be a taste for reading.”—SIR J. HERSCHEL.

A WISE and good man was accustomed, in his devotion, to thank God for books. He did well ; good books, rightly used, are among our greatest blessings. How many solitary hours do they cheer ! How many clouds of sadness do they dispel ! He who loves the society of such constant though silent friends, is never less alone than when alone. They people his solitude ; they refresh him when weary ; animate him when dull. Rarely does he experience purer or higher pleasure than when, escaping, through their aid, from the sense of worldly care and bereavement, he gains, at the same time, an enlarged acquaintance with man and nature, and finds his good resolutions strengthened, his better affections warmed into life. If we court the company of the great, we can always enjoy it through books ; for they introduce us to the noblest minds of our race, and permit us to commune intimately with them, even at those privileged hours when they obtain their brightest visions of truth, and pour forth their loftiest or most touching eloquence.

It must be remembered, however, that all books are not good books, and that even good books may be so read as to fail of their appropriate ends. Milton has said, that “a wise man can sooner gather gold out of the drossiest volume, than a fool wisdom out of Scripture.” It is certain that the effect of reading depends nearly as much on the disposition and taste of the reader, as on the character of the writer. Hence the great importance of considering not only *what* we read, but also in what *way* and for what *ends*.

I. THE OBJECT OF READING.

Many persons take up a book merely that they may dispose of an idle hour, caring little what the book may be, so it enables them to escape from themselves, and never reverting to it when they have once laid it aside. Others read for the same reason that they listen to idle gossip or scandal, perfectly satisfied if they can learn something new. And then, again, there are those, and a very numerous class too, who seek, above all things, to be amused and excited by reading; who resort to a book in much the same spirit that they visit some entertaining spectacle, or as children listen to nursery tales about ghosts and murders. Useful information they are not in quest of, and, of course, do not find. They are averse to the exercise of severe thought. They do not care to have their virtuous sentiments and good resolutions confirmed, or they forget that good books are among the best and simplest means to that end. Anxious only that their passions should

be moved or their mirth awakened, they resort perhaps to Shakspeare, to dwell on his incidents, to trace out his catastrophes and enjoy his coarse humour, while they have scarce a thought for his profound reflections on man, his noble morality, his exquisite pathos, his unstudied but matchless beauty of language and sentiment.

It is not our purpose to recommend that, in selecting books, no regard should be paid to the interest which they are calculated to excite. It is not to be expected, nor indeed is it to be desired, that people should persevere in reading what awakens no curiosity or sympathy. A love for books can be acquired only by those who find pleasure in using them ; and hence, whoever would cultivate in himself or others this most desirable taste, should select, especially at first, such works as can be read with sustained and quickened attention.

But let it not be forgotten, that such books, if read only to amuse and entertain, must, if good, fail of much of their effect, while if bad, their influence will be deplorable. The very fact that in this kind of reading our reflective powers are suspended, and our minds surrendered to the guidance of feeling or imagination, only facilitates injury. We may read the noblest works of our language ; but if we carry to them a vicious or idle taste, we may be sure that that taste will gather its appropriate aliment. By degrading them into instruments of momentary pleasure, we shall lose sight of their true worth, and learn to confound them with that herd of books usually known as “light reading ;” books which seem

to have been written in order to be *once* read, and then forever forgotten. Soon, too, we shall disrel-
ish all books that contain any serious matter, and be
content only with those of the most frivolous or ex-
citing kind. These last will claim every hour which
can be allotted to reading; and happy shall we be
if they do not steal hours that ought to have been
given to duty; happy if, by surrounding us with a
world of fancied beings, who engross our sympathies
and thoughts, they do not destroy our interest in that
other world where the Creator has placed us, and
where he has assigned us an eventful part to act.

To this danger we are peculiarly exposed in our
own day. Books can now be published at an ex-
pense so trifling, and are getting among all classes
of people to be regarded so much as a source of
amusement and recreation, that authors are sorely
tempted to address themselves chiefly to such senti-
ments as are most prevalent and most easily moved.
If this be the case with books, much more is it so
with newspapers and magazines, of which too many
are undertaken for the promotion of private or party
interests, while others, instead of tending to make
men wiser, better, or happier, are found pandering
to their worst passions and their lowest appetites.
He, then, who reads for amusement only, will now
be more than ever likely to draw his pleasure from
poisoned fountains. Nor let him ascribe the respon-
sibility of all this to authors and publishers. They
would hardly send forth impure streams if they had
not found that the reading public thirsts for them.
It is not to be expected that they will employ their

pens and presses in the production of works which cannot be sold. Instead of labouring to *create* a demand for higher or more healthy literature, it is rather their province, they think, to *supply* the one which already exists. It is true, doubtless, that this by no means justifies the public teacher in “prophe-sying falsely” or corruptly; but it is equally true that he would scarcely venture on such prophesyings were it not that “the *people love to have it so.*” Nor should it be forgotten, that the demand for reading which signalizes our age and country, is especially active in towns and cities, where men most seek amusement, and where the idle and vicious are most apt to congregate; that this demand is growing more rapidly among the ignorant and undisciplined than among other classes; and that, as a consequence, the motive to write *down* to the most depraved tastes is every day gaining strength and urgency. Under such circumstances, is it not doubly important that parents and instructors should exercise a careful supervision over the young in their choice of books, and that each one should, for himself, be on his guard against habits of reading which are but too prevalent, and for the indulgence of which the facilities are alike numerous and tempting?

A philosopher, remarkable for his good sense and practical wisdom, has told us, that in forming our habits we should have a reference to the future; and should so fix them that changes will be likely to add to our enjoyment. Among other illustrations of this rule, he gives the following: “A reader who has inured himself to books of science and argumentation,

if a novel, a well-written pamphlet, an article of news, a narrative of a curious voyage, or a journal of a traveller fall in his way, sits down to the repast with relish, enjoys his entertainment while it lasts, and can return when it is over to his graver reading without distaste. Another, with whom nothing will go down but works of humour and pleasantry, or whose curiosity must be interested by perpetual novelty, will consume a bookseller's window in half a forenoon, during which time he is rather in search of diversion than diverted : and as books to his taste are few and short, and rapidly read over, the stock is soon exhausted, when he is left without resource from this principal supply of harmless amusement.”*

The question then recurs, what is the proper object of reading ; what the end to be kept in view in the choice and perusal of books ? One great end, doubtless, is KNOWLEDGE. We enter life ignorant alike of our own nature and of the world around us. Knowing nothing of the properties of matter or mind, or of their modes of operation, we are yet charged with duties which can be performed aright only by those who have such knowledge. Hardly a useful result can be achieved, either for ourselves or others, without deliberation and acquired skill. Instead of being conducted to our ends, like animals, by an infallible instinct, our power is the slow growth of effort—of prudence availing itself of past error—of study, exploring the nature and properties of the material and immaterial objects around us. In order, for instance, to be able to use material substances

* Paley.

aright, we must have observed for ourselves, or learned from others, their qualities and modes of action. So, in order to deal judiciously or rightfully with our fellow-men, we must know something of human nature in general, and of the character of those with whom we deal in particular. We must also understand their relations to us and to others, and the duties resulting from those relations.

It is also to be remembered, that we do not produce results by a power inherent in ourselves, but by enlisting in our behalf those energies and laws of nature which are ever active, and which are efficient alike to aid the enlightened and to thwart the ignorant. Now, to become thoroughly acquainted with these natural laws and powers, we evidently need something more than merely our own personal observation, or the observation of our teachers and neighbours. We need the fruits of all the experience and observation of those who have gone before us; and especially of those whose opportunities for enlarging their acquaintance with nature and the world have been most ample and best improved.

But where shall we find these fruits save in books? How, but by reading, can we carry back our existence to the times when men first began to study the works of God, and to bring to light by experiment the hidden mysteries of nature? In what other way can we enrich ourselves with the experience, and secure for our guidance in life, the collective wisdom of our race? That, without books, man is comparatively powerless, is evident from the condition of savages; who are not only stationary in knowledge

and refinement from age to age, but are also destitute of the simplest accommodations, and ignorant of the most ordinary arts that prevail where books are found. Not only is the knowledge handed down by tradition imperfect, and liable to be corrupted by error, but it is confined to a few points, and is more likely to perpetuate feuds and animosities than to contribute to the improvement and civilization of men. Written records constitute the only authentic memorials of the past ; and, since those records have been multiplied by printing, and spread over the world, they are truly imperishable. Nor only so : they are now the property of the whole race. When books existed only in manuscript, and could be multiplied only by copying, they could instruct but a very small part of mankind. Now, almost all minds experience their enlightening and quickening influence. There is hardly an individual whose knowledge is not enlarged by the use of books ; while, at the same time, multitudes are incited by them to add, by their own labours and discoveries, to the great sum of human attainments.

Another advantage of the knowledge gained from books is, that, instead of being miscellaneous, like that gathered by experience or from intercourse with others, it is much of it arranged and systematized. Thus we are enabled to see the dependance and connexion of different truths ; and, what is more important, we learn to study *principles and laws*, instead of losing ourselves amid a multitude of incongruous facts. By means of senses which we possess in common with brutes, we become acquaint-

ed with the nature of particular objects and events. It is evident, however, that our intellectual progress would be soon arrested, were it not that we are gifted with another faculty denied to brutes—the faculty of looking beyond an event to the principle involved in it. It is thus, by reasoning on particular facts, that we gradually ascend to that knowledge of general laws, which forms our chief prerogative as intellectual beings, and which serves to clothe us with such pre-eminent power and skill as active beings. Wherever this process of inductive reasoning is conducted with care and method, and the results of it are digested into systems and recorded in books, the work of civilization advances, and man enlarges his dominion over nature. On the other hand, there is little civilization where the study of great and comprehensive natural laws is neglected, or is conducted blindly and without method. How important, then, that every one who would cultivate in his own mind the true spirit of investigation, or who would acquire that power which results from knowledge—how important that he should become familiar with such books as illustrate the nature, and embody the fruits of this system of inquiry?

It must be remembered, too, that *reading, to be useful, should be combined with reflection*. Books can afford but little improvement to those who do not *think* as well as read. In order to master truth, we must view it, not merely as an author presents it, but as it stands related to other truths which we have already embraced. The doctrines of the writer must be weighed with a spirit of free but respectful in-

quiry. Whatever principles seem to be established, must be considered in their consequences and causes; and we must reflect how we can make them useful in the commerce of life, and in the discharge of our various duties. We must carry them forth, too, to be tested by practice, and thus learn how far they need to be modified, corrected, or enlarged. Thus we see the great necessity of reading with deliberation; and may I not add, that, in this respect, labouring people, and those whose pursuits give to them almost constant engagement, have advantages which they are not apt to appreciate. By reading at intervals some portion of a good book, and then carrying the matter with them to their places of business as a subject for thought and conversation, they will soon discover that the subject grows upon them in interest; that their views insensibly become clearer and more enlarged, and that useful reflections, not suggested by the author, rise before their minds. And thus it is that men of active pursuits are more apt, as all experience testifies, to accumulate *useful knowledge*, than those whose lives are passed in leisure and in the midst of books. The latter, indeed, often heap up stores of *useless learning*. Their views, too, not being corrected by the lights of experience, are frequently narrow and bigoted; and when called to cope, on the great theatre of life, with minds of a more practical cast and of more active habits, they are found sadly deficient both in readiness and power.

One object of reading, then, is to acquire knowledge. But we must bear in mind that knowledge,

in itself, is not so much an end as a means, and that we are always to keep in view its ulterior uses and applications. No doubt we have been created with a desire for knowledge on its own account, and may find pleasure in the simple contemplation of truth. Let that pleasure be enjoyed. It is not only innocent, but healthy. To be conscious of the power which God has given us, of penetrating the secrets of nature, of looking before and after with large discourse of reason, and of gradually raising our minds to the comprehension of laws and principles ; to cherish the emotions of surprise and admiration, which break upon us as we advance ; to find, moreover, in the survey of such truths food for our spiritual nature, and to be led through this survey to worthy thoughts of Him who first built and still sustains a system so fraught with wonder and beauty, this is a high privilege. But, in addition to this, knowledge brings with it *duties* which are not to be neglected. It is a *talent* or *trust* ; and, to enable us to employ it aright, we should understand well the end for which God has given us capacities for acquiring it. On no subject are men more likely to err ; and how grievous the error is, and in what ways it manifests itself, let Lord Bacon teach. “But the greatest error,” says that great writer, “or all the rest, is the mistaking or misplacing of the last or farthest end of knowledge ; for men have entered into a desire of learning and knowledge, sometimes upon a natural curiosity and inquisitive appetite ; sometimes to entertain their minds with variety and delight ; sometimes for ornament and

reputation ; and sometimes to enable them to victory of wit and contradiction ; and most times for lucre and profession ; and seldom sincerely to give a true account of their gift of reason to the benefit and use of men, as if there were sought in knowledge a couch whereupon to rest a searching and restless spirit ; or a terrace for a wandering and variable mind to walk up and down with a fair prospect ; or a tower of state for a proud mind to raise itself upon ; or a fort or commanding ground for strife and contention ; or a shop for profit or sale, and not *a rich storehouse for the glory of the Creator and the relief of man's estate.*"

Such, then, is the use of knowledge. It constitutes a rich storehouse, whence we should draw materials for glorifying God and improving man's estate. In other words, knowledge is to be employed by us in doing good. In our several stations in life, and in our daily occupations, as parents or children, as citizens, neighbours, friends, and men, it becomes us to seek knowledge, that we may be the better able to answer the claims that rest upon us. He who overlooks this end of knowledge, and seeks it only that he may thereby indulge a vague and idle curiosity, or because he can use it "for ornament and reputation," or "for lucre," or to "enable him to victory of wit and contradiction," such a one not only degrades it—he fails to acquire it. Instead of knowledge, he gathers, to a great extent, only opinions and prejudices ; and, by blunting his mental perceptions, he gradually deprives them of

all power of distinguishing between plausible error and valuable truth.

This remark leads us to notice another of the benefits to be derived from books, when judiciously selected and properly read. This is the *improvement* of our *intellectual powers* and *moral sentiments*. One of the great ends of our probation in this life is to invest us with the perfect control of our faculties, so that we may be able, in every instance, to act virtuously and wisely. In infancy and youth, our powers and sensibilities are governed more by impulse than by deliberation; and hence, though innocent and useful in themselves, they often involve us in error and misfortune. But, by degrees, we may acquire, through culture, that perfect self-command in regard both to our understanding and our feelings, that we can exert any faculty or susceptibility at the proper time and in the proper manner. By due exercise, too, these various powers are continually developed and improved. To take our intellectual faculties as an example: A child finds it very difficult to confine his *attention*, or, by his own act, to transfer it on the instant to a new subject; and still more difficult to entertain more than one subject of thought at the same time. It is only after years of mental discipline that this power can be obtained in perfection by any one; and it is attained, in reality and in a high degree, by very few. But, in proportion as we do acquire it, and in that proportion only, shall we be qualified to consider well and decide wisely the various questions which must often arise in the course of life,

and on the right decision of which will depend not only our own welfare and happiness, but also the happiness and welfare of others. So in regard to *judgment* and *reasoning*. In our daily business we have constant occasion to exercise discrimination and sound judgment. Oftentimes we can ascertain what our interest or duty is only by a course of extended and perhaps complex reasoning; and, unless we are capable of such reasoning, must act at random, or by the dictation of others.

But these several powers are, to a great extent, acquired powers. Hence their cultivation and improvement should be kept in view in reading, as well as in conversation and active life. We should choose books that will exercise the faculty of close and continuous *attention*, and, as we advance, we should subject it to the necessity of more strenuous and protracted effort. They should be books, too, which require us to *think*; which sometimes incline us to close our volume, that we may review the arguments and statements of the writer, and test them by the rules of sound reasoning; books which call us to analyze what is complicated, to arrest what is fugitive, and trace out what is subtle; which suggest new subjects for reflection and inquiry, and gradually lead us to appreciate and enjoy the pleasure that results from the mere exercise of our intellectual powers. Many books are so written as to cultivate a wandering, desultory habit of mind. They either call for no exercise of our reasoning powers, or are vitiated by unsound arguments—arguments which, if assented to, must not only mis-

lead us in relation to the subject under discussion, but, by inducing habits of looseness in regard to all thought, must ever afterward interfere with the right use of our understandings, to whatever subject they may be applied.

So, again, in regard to *taste*. All men have been endowed, though in different degrees, with a relish for what is beautiful or perfect of its kind. This relish is not only a source of pleasure, and, if properly exercised, of refinement, but it may become a spring of improvement also. By inciting us in all our efforts to attain not merely to what is right or good, but also to what is graceful and perfect, it impels us to *advance* in every kind of excellence. It must be remembered, however, that this, like every other susceptibility of our nature, is liable to abuse, and may become, by being perverted, an element of degeneracy, as, by being neglected, it may be weakened and at length paralyzed. Hence books, as well as companions, should be selected with reference to the cultivation not only of the understanding, but also of the taste. And in this respect we are exposed to much danger. Not a few of the works of our day (especially those of a fictitious and periodical character — works, too, which command enthusiastic applause) are directly calculated to encourage a false taste in literature, as well as a vicious tone in manners and morals. Intense expressions, high-sounding words and phrases, sparkling epithets, abrupt transitions, overcharged pictures of life, and turgid representations of outward nature and of human passion, all abound

in many of the works to which I refer. For the young and inexperienced they have many charms, and their influence is often seen in the adoption of a corrupt standard of taste, which is retained through life, or abandoned only after years of misapprehension.

What is true of intellect and taste, is not less true of our *moral sentiments*. That reverence for goodness, that sense of personal responsibility which distinguishes man from animals, is not only a great prerogative, but it is one which needs careful and assiduous culture. Fallible in itself, and impaired through original and actual transgression, it is liable to still further derangement from the corrupting influence of custom and education. And as our moral judgments, moreover, are insensibly but powerfully affected by companions, so are they by books—companions against whom we are apt to be least on our guard, whose instructions we are disposed to receive with a too implicit faith, and whose society we enjoy at those seasons of relaxation when the heart is most open to influence. It is nearly an axiom, that people will not be better than the books they read. If already corrupt, we naturally seek books which do not disturb our self-complacence, nor interfere with our course of indulgence ; and, on the other hand, if uncorrupted as yet, books of a low moral cast may soon do the work of undermining our principles and obscuring all our moral convictions. It is, therefore, a matter of unspeakable importance to the people generally, that our literature should breathe a pure

and lofty spirit. To each individual who would himself be guarded from contamination, or who would do what he may to guard others ; who would strengthen in his own breast and in the breasts of others around him sentiments of honour and religion, it is no less important that all books be proscribed which inculcate indifference to moral distinctions ; which tend, however indirectly or insidiously, to excite our evil passions ; which exhibit the guilty and profligate as objects of sympathy and admiration, or which serve to lessen in the least our reverence for principle, or our hatred of a mean and time-serving policy.

Milton, in his noble “speech of the liberty of unlicensed printing,” has, through a too great eagerness to vindicate the freedom of the press, ventured on apologies for such books which are equally gratuitous and unwarrantable. Not satisfied with maintaining that the printing of them ought to be permitted, he would seem to recommend that they be read as useful trials of virtue. Such trials are sufficiently numerous without the aid of licentious books. They throng along every path trodden by the young. No doubt these writings may be safely and even profitably read by those whose principles are already fixed, and who examine them as the physician examines a contagious disease, that he may better understand its nature and cure. Pure minds may read corrupt books with the same emotions of pity and abhorrence with which they would listen to the profligate sentiments of bad men. Not so, however, with the ignorant and inexperienced.

Their principles are not yet established. Their imaginations are pliant, their feelings warm, and they imbibe but too easily the "leprous distilment."

II. CHOICE OF BOOKS.

In thus explaining the *objects* which ought to be kept in view in reading, I have, in effect, furnished rules for judging of books, of their character and value. If one great end of reading be to enlarge our knowledge, then we should, for the most part, read no books which do not furnish useful information. I say for the most part, because we sometimes read rather to improve taste, quicken and cultivate imagination, or discipline reason, than to gain knowledge. Hence another rule by which we may try a book, is the effect it has upon the understanding. Does it require thought and excite to reflection? Does it deal in *sound* reasoning only, avoiding all specious fallacies, and making no appeals to mere prejudice or passion? Does it cultivate in our minds a disinterested love of truth? If the work in hand be one which professes to *explain* and *prove*, and yet is distinguished by none of these marks, we may at once lay it aside as unworthy our regard. If, on the other hand, it be a work of imagination or taste, it should be tried by its influence on the sensitive part of our nature. If it present us with images of beauty and simplicity, enable us to view the works of nature and art with a keener and more discriminating relish, inspire us with a love for the perfect, and, above all, if it strengthen and animate our nobler sentiments of virtue, it mer-

its frequent and careful perusal. But if otherwise, if we rise from it with no definite impressions of beauty ; if our fancy has been filled and satiated with gorgeous, but confused or unmeaning imagery ; if our generous sympathies have not been moved, nor our virtuous purposes quickened, nor our aspirations raised and ennobled, but if, on the contrary, we close the book with sensibilities enfeebled to the claims of justice, humanity, or truth, in such case I need not add that it is a book to be reprobated and avoided.

III. MANNER OF READING.

Having thus explained the objects of reading, and suggested by what means we can distinguish good books from those which are indifferent or bad, I would, before concluding, add one or two hints in regard to the best manner of using them.

Let me advise, then, in the first place, that *books be read deliberately*. The old maxim, that "if a thing be worth doing at all, it is worth doing well," is peculiarly applicable to reading. A book run over hastily is rarely understood ; if not understood, it is not remembered ; and, if not remembered, the time spent in reading it, is lost. It may be laid down as a universal truth, that time and pains are indispensable in order to make prize of knowledge ; that what is quickly learned is speedily forgotten ; and that, in the mean time, habits of inattention and inaccuracy are forming, which may last through life.

In the second place, some *books should be read in company with others, especially with our family*.

We never relish a good book so highly as when we read it with a friend of congenial tastes. Kindred minds, employed together on the same subject, seem to be quickened through sympathy into a higher activity; the views of the author are comprehended more clearly and thoroughly; they become the subject of discussion; new views are gained, and a deeper impression on the memory is made. And in this plan of social reading, what friends so proper as those of our own household! What employment more appropriate for the domestic circle than one which causes the minds of all to move in unison, thus strengthening the ties of mutual affection, and causing us to associate with home, the remembrance of our intellectual pleasures! How much more rational, as well as innocent, thus to spend the hours allotted to domestic intercourse, than to pass them in frivolous conversation, in detraction, in a round of dull civility, or at cards! It is to be feared that too much of the reading of the present day is solitary. We would exclaim against families who, in place of spreading an inviting table, and collecting their inmates around it to a pleasant and social repast, should leave each one to eat his portion alone. But we hear no protest against the practice, now so prevalent, of leaving each one, even the youngest child, to take his book apart by himself, and devour it with a selfish and impatient haste. The abundance and cheapness of books doubtless contributes to this practice; and what with this abundance at home, and the lectures and other means of instruction which incite us abroad, it will

not be easy to preserve the good old practice of collecting our families around the cheerful fire, and teaching them to relish early the home-bred delights of affection, and of a common intercourse with those best and most improving visiters, good books.

I would recommend, in the third place, that, when we become acquainted with a truly good book, we *read it often*. Cecil tells us that he had a “shelf for tried books;” books which he could never open without being incited to reflection, and enriched by some new hint or principle. It should be so with all of us. A few books, properly selected and faithfully read, would suffice to yield us more both of pleasure and profit, than any number, however great, taken at random, and read, as they usually are, in a hurried and unreflecting manner. A book, moreover, which deserves the praise of being good, has cost its author efforts which cannot be appreciated at a single reading. It embodies lessons of wisdom and duty which cannot be thoroughly comprehended at a glance, and clothes those lessons with beauties which are fully disclosed only to observant and familiar eyes. Who that is accustomed to read Shakspeare or Milton—above all, who that is accustomed to read the Bible, but knows that he can relish their noblest passages, however trite, with a zest and delight which he not only did not feel, but of which he was not capable, when he perused them for the first time. Then he was wholly taken up with the narrative, and his attention was distracted, perhaps, by the incidents. He was too impatient to stop and dwell upon beauties that require study,

nor had he yet formed the taste which would enable him to do full justice to sublime conceptions, impassioned argument, delicate touches of nature, or to that exquisite art which now fills him with admiration and delight.

I add, lastly, one more suggestion in the words of another. Young persons especially will pardon the suggestion, that in no way, perhaps, can their store of applicable knowledge be more certainly, though at first almost imperceptibly, increased, than *by habitually reading with a pen in the hand*. There is much good sense in these doggerel verses, for which we are indebted to no ordinary thinker.

“In reading authors, when you find
Bright passages that strike your mind,
And which, perhaps, you may have reason
To think on at another season,
Be not contented with the sight,
But take them down in black and white ;
Such a respect is wisely shown,
As makes another’s sense one’s own.”

One caution, however, is here indispensable : that, by deep and diligent meditation, we acquire something which may truly be called our own : for, as Milton says,

“Who reads
Incessantly, and to his reading brings not
A spirit and judgment equal or superior,
Uncertain and unsettled still remains,
Deep versed in books, and shallow in himself.”

I have thus indicated some of the answers which may be given to the three great questions that arise in regard to reading, viz., 1st. *Why should we read?* 2dly. *What should we read?* 3dly. *How should we*

read? These answers may be expressed briefly thus :

I. WHY SHOULD WE READ ?

Partly to procure immediate gratification, but principally, 1st, to acquire knowledge both for its own sake and for its uses : 2dly, to improve the intellectual powers : 3dly, to refine taste : and 4thly, to strengthen the moral and religious sentiments.

II. WHAT SHOULD WE READ ?

Only good books ; which Milton describes as “ the precious life-blood of master-spirits, embalmed and treasured up on purpose to a life beyond life.” To know whether a book be good, consider, 1st, whether it adds to our sum of knowledge : 2dly, whether it induces thought and exercises reason : 3dly, whether it improves taste : and 4thly, whether it strengthens conscience.

III. HOW SHOULD WE READ ?

1st, Thoughtfully and critically : 2dly, in company with a friend, or with our family : 3dly, repeatedly : 4thly, with pen in hand.

A D I S C O U R S E
ON THE
OBJECTS, ADVANTAGES, AND PLEASURES
OF
S C I E N C E.

BY HENRY LORD BROUGHAM.



OBJECTS, ADVANTAGES, AND PLEASURES

OF

S C I E N C E.

INTRODUCTION.

IN order fully to understand the advantages and the pleasures which are derived from an acquaintance with any science, it is necessary to become acquainted with that science ; and it would, therefore, be impossible to convey a complete knowledge of the benefits conferred by a study of the various sciences which have hitherto been cultivated by philosophers, without teaching all the branches of them. But a very distinct idea may be given of those benefits, by explaining the nature and objects of the different sciences : it may be shown, by examples, how much use and gratification there is in learning a part of any one branch of knowledge ; and it may thence be inferred how great reason there is to learn the whole.

It may easily be demonstrated, that there is an advantage in learning, both for the usefulness and the pleasure of it. There is something positively agreeable to all men—to all, at least, whose nature is not most grovelling and base—in gaining knowledge for its own sake. When you see anything for the first

time, you at once derive some gratification from the sight, being new ; your attention is awakened, and you desire to know more about it. If it is a piece of workmanship, as an instrument, a machine of any kind, you wish to know how it is made, how it works, and what use it is of. If it is an animal, you desire to know where it comes from, how it lives, what are its dispositions, and, generally, its nature and habits. You feel this desire, too, without at all considering that the machine or the animal may ever be of the least use to yourself practically ; for, in all probability, you may never see them again. But you have a curiosity to learn all about them, because they are new and unknown. You accordingly make inquiries ; you feel a gratification in getting answers to your questions, that is, in receiving information, and in knowing more : in being better informed than you were before. If you happen again to see the same instrument or animal, you find it agreeable to recollect having seen it formerly, and to think that you know something about it. If you see another instrument or animal, in some respects like, but differing in other particulars, you find it pleasing to compare them together, and to note in what they agree and in what they differ. Now all this kind of gratification is of a pure and disinterested nature, and has no reference to the common purposes of life ; yet it is a pleasure, an enjoyment. You are nothing the richer for it ; you do not gratify your palate or any other bodily appetite ; and yet it is so pleasing that you would give something out of your pocket to obtain it, and would forego some bodily enjoy-

ment for its sake. The pleasure derived from science is exactly of the like nature, or, rather, it is the very same. For what has just been spoken of is in fact science, which, in its most comprehensive sense, only means *knowledge*, and in its ordinary sense means *knowledge reduced to a system*; that is, arranged in regular order so as to be conveniently taught, easily remembered, and readily applied. †

The practical uses of any science or branch of knowledge are undoubtedly of the highest importance; and there is hardly any man who may not gain some positive advantage in his worldly wealth and comforts by increasing his stock of information. But there is also a pleasure in seeing the uses to which knowledge may be applied, wholly independent of the share we ourselves may have in those practical benefits. It is pleasing to examine the nature of a new instrument, or the habits of an unknown animal, without considering whether or not they may ever be of use to ourselves or to anybody. It is another gratification to extend our inquiries, and find that the instrument or animal is useful to man, even although we have no chance ourselves of ever benefiting by the information: as, to find that the natives of some distant country employ the animal in travelling; nay, though we have no desire of benefiting by the knowledge; as, for example, to find that the instrument is useful in performing some dangerous surgical operation. The mere gratification of curiosity; the knowing more to-day than we knew yesterday; the understanding clearly what before seemed obscure and puzzling; the contemplation of

general truths, and the comparing together of different things, is an agreeable occupation of the mind ; and, besides the present enjoyment, elevates the faculties above low pursuits, purifies and refines the passions, and helps our reason to assuage their violence.

It is very true that the fundamental lessons of philosophy may to many, at first sight, wear a forbidding aspect, because to comprehend them requires an effort of the mind, somewhat, though certainly not much greater than is wanted for understanding more ordinary matters ; and the most important branches of philosophy, those which are of the most general application, are for that very reason the less easily followed, and the less entertaining when apprehended, presenting as they do few particulars or individual objects to the mind. In discoursing of them, moreover, no figures will be at present used to assist the imagination ; the appeal is made to reason without help from the senses. But be not, therefore, prejudiced against the doctrine, that the pleasure of learning the truths which philosophy unfolds is truly above all price. Lend but a patient attention to the principles explained ; and, giving us credit for stating nothing which has not some practical use belonging to it, or some important doctrine connected with it, you will soon perceive the value of the lessons you are learning, and begin to interest yourselves in comprehending and recollecting them ; you will find that you have actually learned something from science, while merely engaged in seeing what its end and purpose is ; you will be enabled to calculate for yourselves

how far it is worth the trouble of acquiring, by examining samples of it ; you will, as it were, taste a little, to try whether or not you relish it, and ought to seek after more ; you will enable yourselves to go on and enlarge your stock of it ; and, after having first mastered a very little, you will proceed so far as to look back with wonder at the distance you have reached beyond your earliest acquirements.

The sciences may be divided into three great classes : those which relate to *Number and Quantity* ; those which relate to *Matter* ; and those which relate to *Mind*. The first are called the *Mathematics*, and teach the properties of numbers and of figures ; the second are called *Natural Philosophy*, and teach the properties of the various bodies which we are acquainted with by means of our senses ; the third are called *Intellectual* or *Moral Philosophy*, and teach the nature of the mind, of the existence of which we have the most perfect evidence in our own reflections ; or, in other words, they teach the moral nature of man, both as an individual and as a member of society. Connected with all the sciences, and subservient to them, though not one of their number, is *History*, or the record of facts relating to all kinds of knowledge.

I. MATHEMATICAL SCIENCE.

The two great branches of the *Mathematics*, or the two mathematical sciences, are *Arithmetic*, the science of number, from the Greek word signifying *number* ; and *Geometry*, the science of figure, from the Greek words signifying *measure of the earth*,

land-measuring having first turned men's attention to it.

When we say that 2 and 2 make 4, we state an arithmetical proposition, very simple indeed, but connected with many others of a more difficult and complicated kind. Thus it is another proposition, somewhat less simple, but still very obvious, that 5 multiplied by 10, and divided by 2, is equal to, or makes the same number with, 100 divided by 4, both results being equal to 25. So, to find how many farthings there are in 1000*l.*, and how many minutes in a year, are questions of arithmetic which we learn to work by being taught the principles of the science one after another, or, as they are commonly called, the *rules* of addition, subtraction, multiplication, and division. Arithmetic may be said to be the most simple, though among the most useful of the sciences; but it teaches only the properties of particular and known numbers, and it only enables us to add, subtract, multiply, and divide those numbers. But suppose we wish to add, subtract, multiply, or divide numbers which we have not yet ascertained, and in all respects to deal with them as if they were known, for the purpose of arriving at certain conclusions respecting them, and, among other things, of discovering what they are; or, suppose we would examine properties belonging to all numbers; this must be performed by a peculiar kind of arithmetic, called *Universal* arithmetic, or *Algebra*.* The

* Algebra, from the Arabic words signifying the *reduction of fractions*; the Arabs having brought the knowledge of it into Europe.

common arithmetic, you will presently perceive, carries the seeds of this most important science in its bosom. Thus, suppose we inquire what is the number which, multiplied by 5, makes 10? This is found if we divide 10 by 5—it is 2: but suppose that, before finding this number 2, and before knowing what it is, we would add it, whatever it may turn out, to some other number; this can only be done by putting some mark, such as a letter of the alphabet, to stand for the unknown number, and adding that letter as if it were a known number. Thus, suppose we want to find two numbers, which, added together, make 9, and multiplied by one another, make 20. There are many which, added together, make 9; as, 1 and 8; 2 and 7; 3 and 6; and so on. We have therefore occasion to use the second condition, that, multiplied by one another, they should make 20, and to work upon this condition before we have discovered the particular numbers. We must therefore suppose the numbers to be found, and put letters for them; and, by reasoning upon those letters, according to both the two conditions of adding and multiplying, we find what they must each of them be in figures, in order to fulfil or answer the conditions. Algebra teaches the rules for conducting this reasoning, and obtaining this result successfully; and by means of it we are enabled to find out numbers which are unknown, and of which we only know that they stand in certain relations to known numbers, or to one another. The instance now taken is an easy one; and you could, by considering the question a little, answer it readily

enough ; that is, by trying different numbers, and seeing which suited the conditions ; for you plainly see that 5 and 4 are the two numbers sought ; but you see this by no certain or general rule applicable to all cases, and therefore you could never work more difficult questions in the same way ; and even questions of a moderate degree of difficulty would take an endless number of trials or guesses to answer. Thus, a shepherd sold his flock for 80*l.* ; and if he had sold four sheep more for the same money, he would have received one pound less for each sheep. To find out, from this, how many the flock consisted of, is a very easy question in algebra, but would require a vast many guesses, and a long time to hit upon by common arithmetic.* And questions infinitely more difficult can easily be solved by the rules of algebra. In like manner, by arithmetic you can tell the properties of particular numbers ; as, for instance, that the number 348 is divided by 3 exactly, so as to leave nothing over : but algebra teaches us that it is only one of an infinite variety of numbers, all divisible by 3, and any one of which you can tell the moment you see it ; for they all have the remarkable property, that, if you add together the figures they consist of, the sum total is divisible by 3. You can easily perceive this in any one case, as in the number mentioned ; for 3 added to 4, and that to 8, make 15, which is plainly divisible by 3 ; and if you divide 348 by 3, you find the quotient to be 116, with nothing over. But this

* It is 16.

does not at all prove that any other number, the sum of whose figures is divisible by 3, will itself also be found divisible by 3, as 741; for you must actually perform the division here, and in every other case, before you can know that it leaves nothing over. Algebra, on the contrary, both enables you to discover such general properties, and to prove them in all their generality.*

By means of this science and its various applications, the most extraordinary calculations may be performed. We shall give, as an example, the method of *Logarithms*, which proceeds upon this principle. Take a set of numbers going on by equal differences; that is to say, the third being as much greater than the second, as the second is greater than the first, and the common difference being the number you begin with; thus, 1, 2, 3, 4, 5, 6, and so on, in which the common difference is 1: then take another set of numbers, such that each is equal to twice or three times the one before it, or any number of times the one before it, but the common multiplier being the number you begin with; thus, 2, 4, 8, 16, 32, 64, 128; write this second

* Another class of numbers divisible by 3 is discovered in like manner by Algebra. Every number of three places, the figures (or digits) composing which are in arithmetical progression (or rise above each other by equal differences), is divisible by 3: as, 123, 789, 357, 159, and so on. The same is true of numbers of any amount of places, provided they are composed of 3, 6, 9, &c., numbers arising above each other by equal differences, as 289, 299, 309, or 148, 214, 280, or 307142085345648276198756, which number of 24 places is divisible by 3, being composed of 6 numbers in a series whose common difference is 1137. This property, too, is only a particular case of a much more general one.

set of numbers under the first, or side by side, so that the numbers shall stand opposite to one another, thus :

1	2	3	4	5	6	7
2	4	8	16	32	64	128

you will find, that if you add together any two of the upper or first set, and go to the number opposite their sum in the lower or second set, you will have in this last set the number arising from multiplying together the numbers of the lower set corresponding or opposite to the numbers added together. Thus, add 2 to 4, you have six in the upper set, opposite to which in the lower set is 64, and multiplying the numbers 4 and 16 opposite to 2 and 4, the product is 64. In like manner, if you subtract one of the upper numbers from another, and opposite to their difference in the upper line, you look to the lower number, it is the quotient found from dividing one of the lower numbers by the other opposite to the subtracted ones. Thus, take 4 from 6 and 2 remains, opposite to which you have in the lower line 4 ; and if you divide 64, the number opposite to 6, by 16, the number opposite to 4, the quotient is 4. The upper set are called the *logarithms* of the lower set, which are called *natural numbers* ; and tables may, with a little trouble, be constructed, giving the logarithms of all numbers from 1 to 10,000 and more : so that, instead of multiplying or dividing one number by another, you have only to add or subtract their logarithms, and then you at once find the product or the quotient in the tables. These are made applicable to numbers

far higher than any actually in them, by a very simple process: so that you may at once perceive the prodigious saving of time and labour which is thus made. If you had, for instance, to multiply 7,543,283 by itself, and that product again by the original number, you would have to multiply a number of 7 places of figures by an equally large number, and then a number of 14 places of figures by one of 7 places, till at last you had a product of 21 places of figures—a very tedious operation; but, working by logarithms, you would only have to take three times the logarithm of the original number, and that gives the logarithm of the last product of 21 places of figures, without any farther multiplication. So much for the time and trouble saved, which is still greater in questions of division; but by means of logarithms many questions can be worked, and of the most important kind, which no time or labour would otherwise enable us to resolve.

Geometry teaches the properties of figure, or particular portions of space, and distances of points from each other. Thus, when you see a triangle or three-sided figure, one of whose sides is perpendicular to another side, you find, by means of geometrical reasoning respecting this kind of triangle, that if squares be drawn on its three sides, the large square upon the slanting side opposite the two perpendiculars is exactly equal to the two smaller squares upon the perpendiculars taken together; and this is absolutely true, whatever be the size of the triangle, or the proportions of its sides to each other. Therefore, you can always find the length of

any one of the three sides by knowing the lengths of the other two. Suppose one perpendicular side to be 3 feet long, the other 4, and you want to know the length of the third side opposite to the perpendicular ; you have only to find a number such, that, if multiplied by itself, it shall be equal to 3 times 3, together with 4 times 4, that is 25.* (This is number 5.)

Now only observe the great advantage of knowing this property of the triangle, or of perpendicular lines. If you want to measure a line passing over ground which you cannot reach—to know, for instance, the length of one side covered with water of a field, or the distance of one point on a lake or bay from another point on the opposite side—you can easily find it by measuring two lines perpendicular to one another on the dry land, and running through the two points ; for the line wished to be measured, and which runs through the water, is the third side of a perpendicular-sided triangle, the other two sides of which are ascertained. But there are other properties of triangles, which enable us to know the length of two sides of any triangle, whether it has perpendicular sides or not, by measuring one side, and also measuring the inclinations of the other two sides to this side, or what is called the two *angles* made by those sides with the measured side. There-

* It is a property of numbers, that every number whatever, whose last place is either 5 or 0, is, when multiplied into itself, equal to two others which are square numbers, and divisible by 3 and 4 respectively: thus, $45 \times 45 = 2025 = 729 + 1296$, the squares of 27 and 36 ; and $60 \times 60 = 3600 = 1296 + 2304$, the squares of 36 and 48.

fore you can easily find the perpendicular line drawn, or supposed to be drawn, from the top of a mountain through it to the bottom, that is the height of the mountain;—for you can measure a line on level ground, and also the inclination of two lines, supposing them drawn in the air, and reaching from the two ends of the measured line to the mountain's top; and having thus found the length of the one of those lines next the mountain, and its inclination to the ground, you can at once find the perpendicular, though you cannot possibly get near it. In the same way, by measuring lines and angles on the ground, and near, you can find the length of lines at a great distance, and which you cannot approach: for instance, the length and breadth of a field on the opposite side of a lake or sea; the distance of two islands, or the space between the tops of two mountains.

Again, there are *curve-lined* figures as well as straight, and geometry teaches the properties of these also. The best known of all the curves is the *circle*, or a figure made by drawing a string round one end which is fixed, and marking where its other end traces, so that every part of the circle is equally distant from the fixed point or centre. From this fundamental property, an infinite variety of others follow by steps of reasoning more or less numerous, but all necessarily arising out of one another. To give an instance: it is proved by geometrical reasoning, that if from the two ends of any diameter of the circle you draw two lines to meet in

any one point of the circle whatever, those lines are perpendicular to each other.

Another property, and a most useful one, is, that the sizes or areas of all circles whatever, from the greatest to the smallest, from the sun to a watch-dial-plate, are in exact proportion to the squares of their distances from the centre ; that is, the squares of the strings they are drawn with ; so that if you draw a circle with a string 5 feet long, and another with a string 10 feet long, the large circle is four times the size of the small one, as far as the space or area enclosed is concerned ; the square of 10 or 100 being four times the square of 5 or 25. But it is also true, that the lengths of the circumferences themselves, the number of feet over which the ends of the strings move, are in proportion to the lengths of the strings ; so that the curve of the larger circle is only twice the length of the curve of the lesser.

But the circle is only one of an infinite variety of curves, all having a regular formation and fixed properties. The *oval* or *ellipse* is, perhaps, next to the circle, the most familiar to us, although we more frequently see another curve, the line formed by the motion of bodies thrown forward. When you drop a stone, or throw it straight up, it goes in a straight line ; when you throw it forward, it goes in a curve line till it reaches the ground ; as you may see by the figure in which water runs when forced out of a pump, or from a fire-pipe, or from the spout of a kettle or teapot. The line it moves in is called a *parabola* ; every point of which bears a certain fixed relation to a certain point within it, as the circle does

to its centre. Geometry teaches various properties of this curve ; for example, if the direction in which the stone is thrown, or the bullet fired, or the water spouted, be half the perpendicular to the ground, that is, half way between being level with the ground and being upright, the curve will come to the ground at a greater distance than if any other direction whatever were given, with the same force. So that to make the gun carry farthest, or the fire-pipe play to the greatest distance, they must be pointed, not, as you might suppose, level or point blank, but about half way between that direction and the perpendicular. If the air did not resist, and so somewhat disturb the calculation, the direction to give the longest range ought to be exactly half perpendicular.

The *oval*, or *ellipse*, is drawn by taking a string of any certain length, and fixing, not one end as in drawing the circle, but both ends to different points, and then carrying a point round inside the string, always keeping it stretched as far as possible. It is plain that this figure is as regularly drawn as the circle, though it is very different from it ; and you perceive that every point of its curve must be so placed, that the straight lines drawn from it to the two points where the string was fixed, are, when added together, always the same ; for they make together the length of the string.

Among various properties belonging to this curve, in relation to the straight lines drawn within it, is one which gives rise to the construction of the *trammels*, or elliptic compasses, used for making figures and

ornaments of this form ; and also to the construction of lathes for turning oval frames and the like.

If you wish at once to see these three curves, take a pointed sugar-loaf, and cut it anywhere clean through in a direction parallel to its base or bottom ; the outline or edge of the loaf where it is cut will be a *circle*. If the cut is made so as to slant, and not be parallel to the base of the loaf, the outline is an *ellipse*, provided the cut goes quite through the sides of the loaf all round, or is in such a direction that it would pass through the sides of the loaf were they extended ; but if it goes slanting and parallel to the line of the loaf's side, the outline is a *parabola* ; and if you cut in any direction, not through the sides all round, but through the sides and base, and not parallel to the line of the side, being nearer the perpendicular, the outline will be another curve, of which we have not yet spoken, but which is called an *hyperbola*. You will see another instance of it if you take two plates of glass and lay them on one another ; then put their edge in water, holding them upright and pressing them together ; the water, which, to make it more plain, you may colour with a few drops of ink or strong tea, rises to a certain height, and its outline is this curve ; which, however much it may seem to differ in form from a circle or ellipse, is found by mathematicians to resemble them very closely in many of its most remarkable properties.

These are the curve lines best known and most frequently discussed ; but there are an infinite number of others, all related to straight lines and other

curve lines by certain fixed rules ; for example, the course which any point in the circumference of a circle, as a nail in the felly of a wheel rolling along, takes through the air, is a curve called the *cycloid*, which has many remarkable properties ; and, among others, this, that it is, of all lines possible, the one in which any body, not falling perpendicularly, will descend from one point to another the most quickly. Another curve often seen is that in which a rope or chain hangs when supported at both ends ; it is called the *Catenary*, from the Latin for chain ; and in this form some arches are built. The form of a sail filled with the wind is the same curve.

II. DIFFERENCE BETWEEN MATHEMATICAL AND PHYSICAL TRUTHS.

You perceive, if you reflect a little, that the science which we have been considering, in both its branches, has nothing to do with matter ; that is to say, it does not at all depend upon the properties or even upon the existence of any bodies or substances whatever. The distance of one point or place from another is a straight line ; and whatever is proved to be true respecting this line—as, for instance, its proportion to other lines of the same kind, and its inclination towards them, what we call the *angles* it makes with them—would be equally true whether there were anything in those places, at those two points, or not. So, if you find the number of yards in a square field by measuring one side, 100 yards, and then multiplying that by itself, which makes the whole area 10,000 square yards, this is equally true

whatever the field is, whether corn, or grass, or rock, or water ; it is equally true if the solid part, the earth or water, be removed, for then it will be a field of air bounded by four walls or hedges ; but suppose the walls or hedges were removed, and a mark only left at each corner, still it would be true that the space enclosed or bounded by the lines supposed to be drawn between the four marks was 10,000 square yards in size. But the marks need not be there ; you only want them while measuring one side ; if they were gone, it would be equally true, that the lines supposed to be drawn from the places where the marks had been enclose 10,000 square yards of air. But if there were no air, and, consequently, a mere void or empty space, it would be equally true that this space is of the size you had found it to be by measuring the distance of one point from another, of one of the space's corners or angles from another, and then multiplying that distance by itself. In the same way it would be true, that, if the space were circular, its size, compared with another circular space of half its diameter, would be four times larger ; of one third its diameter, nine times larger ; and of one fourth, sixteen times ; and so on, always in proportion to the squares of the diameters ; and that the length of the circumference, the number of feet or yards in the line round the surface, would be twice the length of a circle whose diameter was one half, thrice the circumference of one whose diameter was one third, four times the circumference of one whose diameter was one fourth, and so on, in the simple proportion of the diame-

ters. Therefore, every property which is proved to belong to figures belongs to them without the smallest relation to bodies or matter of any kind, although we are accustomed only to see figures in connexion with bodies ; but all those properties would be equally true if no such thing as matter or bodies existed ; and the same may be said of the properties of number, the other great branch of the mathematics. When we speak of twice two, and say it makes four, we affirm this without thinking of two horses, or two balls, or two trees ; but we assert it concerning two of anything and everything equally. Nay, this branch of mathematics may be said to apply still more extensively than even the other ; for it has no relation to space, which geometry has ; and, therefore, it is applicable to cases where figure and size are wholly out of the question. Thus you can speak of two dreams, or two ideas, or two minds, and can calculate respecting them just as you would respecting so many bodies ; and the properties you find belonging to numbers, will belong to those numbers when applied to things that have no outward, or visible, or perceivable existence, and cannot even be said to be in any particular place, just as much as the same numbers applied to actual bodies which may be seen and touched.

It is quite otherwise with the science which we are now going to consider, *Natural Philosophy*. This teaches the nature and properties of actually existing substances, their motions, their connexions with each other, and their influence on one another. It is sometimes also called *Physics*, from the Greek

word signifying *Nature*, though that word is more frequently, in common speech, confined to one particular branch of the science, that which treats of the bodily health.

We have mentioned one distinction between Mathematics and Natural Philosophy, that the former does not depend on the nature and existence of bodies, which the latter entirely does. Another distinction, and one closely connected with this is, that the truths which Mathematics teach us are *necessarily such*; they are truths of themselves, and wholly independent of facts and experiments; they depend only upon reasoning; and it is utterly impossible they should be otherwise than true. This is the case with all the properties which we find belong to numbers and to figures; 2 and 2 must of *necessity*, and through all time and in every place, be equal to 4: those numbers must *necessarily* be always divisible by 3, without leaving any remainder over, which have the sums of the figures they consist of divisible by three; and circles must *necessarily*, and for ever and ever, be to one another in the exact proportion of the squares of their diameters. It cannot be otherwise; we cannot conceive it in our minds to be otherwise. No man can in his own mind suppose to himself that 2 and 2 should ever be more or less than 4; it would be an utter impossibility, a contradiction in the very ideas; and, if stated in words, those words would have no sense. The other properties of number, though not so plain at first sight as this, are proved to be true by reasoning, every one step of which follows from the step immediately before as a matter

of course, and so clear and unavoidably, that it cannot be supposed, or even imagined to be otherwise ; the mind has no means of fancying how it could be otherwise ; the final conclusion from all the steps of the reasoning or demonstration, as it is called, follows in the same way from the last of the steps, and is therefore just as evidently and necessarily true as the first step, which is always something self-evident ; for instance, that 2 and 2 make 4, or that the whole is greater than any of its parts, but equal to all its parts put together. It is through this kind of reasoning, step by step, from the most plain and evident things, that we arrive at the knowledge of other things, which seem at first not true, or, at least, not generally true ; but when we do arrive at them, we perceive that they are just as true, and for the same reasons, as the first and most obvious matters ; that their truth is absolute and necessary, and that it would be absurd and self-contradictory to suppose they ever could, under any circumstances, be not true, as to suppose that 2 added to 2 could ever make 3, or 5, or 100, or anything but 4 ; or, which is the same thing, that 4 should ever be equal to 3, or 5, or 100, or anything but 4. To find out these reasonings, to pursue them to their consequences, and thereby to discover the truths which are not immediately evident, is what science teaches us ; but when the truth is once discovered, it is as certain and plain by the reasoning as the first truths themselves, from which all the reasoning takes its rise, on which it all depends, and which require no proof, because they are self-evident at once, and must be assented to the instant they are understood.

But it is quite different with the truths which Natural Philosophy teaches. All these depend upon matter of fact ; and that is learned by observation and experiment, and never could be discovered by reasoning at all. If a man were shut up in a room with pen, ink, and paper, he might, by thinking, discover any of the truths in arithmetic, algebra, or geometry ; it is possible at least ; there would be nothing absolutely impossible in his discovering all that is now known of these sciences ; and if his memory were as good as we are supposing his judgment and conception to be, he might discover it all without pen, ink, and paper, and in a dark room. But we cannot discover a single one of the fundamental properties of matter without observing what goes on around us, and trying experiments upon the nature and motion of bodies. Thus the man whom we have supposed shut up, could not possibly find out beyond one or two of the very first properties of matter, and those only in a very few cases ; so that he could not tell if these were general properties of all matter or not. He could tell that the objects he touched in the dark were hard and resisted his touch ; that they were extended and were solid ; that is, that they had three dimensions, length, breadth, and thickness. He might guess that other things existed besides those he felt, and that those other things resembled what he felt in these properties ; but he could know nothing for certain, and could not even conjecture much beyond this very limited number of qualities. He must remain utterly ignorant of what really exists in nature, and of what properties matter in general has. These

properties, therefore, we learn by experience ; they are such as we know bodies to have ; they happen to have them—they are so formed by Divine Providence as to have them—but they might have been otherwise formed ; the great Author of Nature might have thought fit to make all bodies different in every respect. We see that a stone dropped from our hand falls to the ground ; this is a fact which we can only know by experience ; before observing it we could not have guessed it, and it is quite *conceivable* that it should be otherwise ; for instance, that when we remove our hand from the body, it should stand still in the air, or fly upward, or go forward, or backward, or sideways ; there is nothing at all absurd, contradictory, or inconceivable in any of these suppositions ; there is nothing impossible in any of them, as there would be in supposing the stone equal to half of itself, or double of itself, or both falling down or rising upward at once, or going to the right and the left at one and the same time. Our only reason for not at once thinking it quite conceivable that the stone should stand still in the air, or fly upward, is, that we have never seen it do so, and have become accustomed to see it do otherwise. But for that, we should at once think it as natural that the stone should fly upward or stand still, as that it should fall down. But no degree of reflection for any length of time could accustom us to think 2 and 2 equal to anything but 4, or to believe the whole of anything equal to a part of itself.

After we have once, by observation or experiment, ascertained certain things to exist in fact, we may

then reason upon them by means of the mathematics ; that is, we may apply mathematics to our experimental philosophy, and then such reasoning becomes absolutely certain, taking the fundamental facts for granted. Thus, if we find that a stone falls in one direction when dropped, and we farther observe the peculiar way in which it falls, that is, quicker and quicker every instant till it reaches the ground, we learn the rule or the proportion by which the quickness goes on increasing ; and we farther find, that if the same stone is pushed forward on a table, it moves in the direction of the push till it is either stopped by something, or comes to a pause by rubbing against the table and being hindered by the air. These are facts which we learn by observing and trying, and they might all have been different if matter and motion had been otherwise constituted ; but supposing them to be as they are and as we find them, we can, by reasoning mathematically from them, find out many most curious and important truths depending upon those facts, and depending upon them, not accidentally, but of necessity. For example, we can find in what course the stone will move, if, instead of being dropped to the ground, it is thrown forward ; it will go in the curve already mentioned, the parabola, somewhat altered by the resistance of the air, and it will run through that curve in a peculiar way, so that there will always be a certain proportion between the time it takes and the space it moves through, and the time it would have taken, and the space it would have moved through had it dropped from the hand in a straight line to the ground.

So we can prove, in like manner, what we before stated of the relation between the distance at which it will come to the ground and the direction it is thrown in ; the distance being greatest of all when the direction is half way between the level or horizontal, and the upright or perpendicular. These are mathematical truths, derived by mathematical reasoning upon physical grounds ; that is, upon matter of fact found to exist by actual observation and experiment. The result, therefore, is necessarily true, and proved to be so by reasoning only, provided we have once ascertained the facts ; but, taken altogether, the result depends partly on the facts learned by experiment or experience, partly on the reasoning from these facts. Thus it is found to be true by reasoning, and necessarily true, that *if* the stone falls in a certain way when unsupported, it must, when thrown forward, go in the curve called the parabola, provided there be no air to resist : this is a necessary or mathematical truth, and it cannot possibly be otherwise. But when we state the matter without any supposition—without any “*if*,”—and say, a stone thrown forward goes in a curve called a parabola, we state a truth, partly fact, and partly drawn from reasoning on the fact ; and it might be otherwise if the nature of things were different. It is called a proposition or truth in Natural Philosophy ; and as it is discovered and proved by mathematical reasoning upon facts in nature, it is sometimes called a proposition or truth in the *Mixed Mathematics*, so named in contradistinction to the *Pure Mathematics*, which are employed in reasoning upon figures and numbers. The

man in the dark room could never discover this truth, unless he had been first informed by those who had observed the fact, in what way the stone falls when unsupported, and moves along the table when pushed. These things he never could have found out by reasoning; they are facts, and he could only reason from them after learning them by his own experience, or taking them on the credit of other people's experience. But, having once so learned them, he could discover by reasoning merely, and with as much certainty as if he lived in daylight, and saw and felt the moving body, that the motion is in a parabola, and governed by certain rules. As experiment and observation are the great sources of our knowledge of nature, and as the judicious and careful making of experiments is the only way by which her secrets can be known, Natural and Experimental Philosophy mean one and the same thing; mathematical reasoning being applied to certain branches of it, particularly those which relate to motion and pressure.

III. NATURAL OR EXPERIMENTAL SCIENCE.

Natural Philosophy, in its most extensive sense, has for its province the investigation of the laws of matter, that is, the properties and the motions of matter; and it may be divided into two great branches. The first and most important (which is sometimes, on that account, called *Natural Philosophy*, by way of distinction, but more properly *Mechanical Philosophy*) investigates the sensible motion of bodies. The second investigates the constitution and qualities of all bodies, and has various names, according

to its different objects. It is called *Chymistry* if it teaches the properties of bodies with respect to heat, mixture with one another, weight, taste, appearance, and so forth; *Anatomy* and *Animal Physiology* (from the Greek word signifying *to speak of the nature* of anything) if it teaches the structure and function of living bodies, especially the human; for, when it shows those of other animals, we term it *Comparative Anatomy*; *Medicine* if it teaches the nature of diseases, and the means of preventing them and of restoring health; *Zoology* (from the Greek word signifying *to speak of animals*) if it teaches the arrangement or classification and the habits of the different lower animals; *Botany* (from the Greek word for *herbage*), including *Vegetable Physiology*, if it teaches the arrangement or classification, the structure and habits of plants; *Mineralogy*, including *Geology* (from the Greek words meaning *to speak of the earth*), if it teaches the arrangement of minerals, the structure of the masses in which they are found, and of the earth composed of those masses. The term *Natural History* is given to the three last branches taken together, but chiefly as far as they teach the classification of different things, or the observation of the resemblances and differences of the various animals, plants, and inanimate and ungrowing substances in nature.

But here we may make two general observations. The *first* is, that every such distribution of the sciences is necessarily imperfect; for one runs unavoidably into another. Thus *Chymistry* shows the qualities of plants with relation to other substances

and to each other; and Botany does not overlook those same qualities, though its chief object be arrangement. So Mineralogy, though principally conversant with classifying metals and earths, yet regards also their qualities in respect of heat and mixture. So, too, Zoology, besides arranging animals, describes their structures like Comparative Anatomy. In truth, all arrangement and classifying depend upon noting the things in which the objects agree and differ; and among those things in which animals, plants, and minerals agree or differ, must be considered the anatomical qualities of the one, and the chymical qualities of the other. From hence, in a great measure, follows the *second* observation, namely, that the sciences mutually assist each other. We have seen how Arithmetic and Algebra aid Geometry, and how both the purely Mathematical Sciences aid Mechanical Philosophy. Mechanical Philosophy, in like manner, assists, though in the present state of our knowledge not very considerably, both Chymistry and Anatomy, especially the latter; and Chymistry very greatly assists both Physiology, Medicine, and all the branches of Natural History.

The first great head, then, of Natural Science, is Mechanical Philosophy; and it consists of various subdivisions, each forming a science of great importance. The most essential of these, and which is indeed fundamental, and applicable to all the rest, is called *Dynamics*, from the Greek word signifying *power* or *force*, and it teaches the laws of motion in all its varieties. The case of the stone thrown

forward, which we have already mentioned more than once, is an example. Another, of a more general nature, but more difficult to trace, far more important in its consequences, and of which, indeed, the former is only one particular case, relates to the motions of all bodies which are attracted (influenced or drawn) by any power towards a certain point, while they are, at the same time, driven forward by some push given to them at first and forcing them onward, at the same time that they are drawn towards the point. The line in which a body moves while so drawn and so driven, depends upon the force it is pushed with, the direction it is pushed in, and the kind of power that draws it towards the point; but at present we are chiefly to regard the latter circumstance, the attraction towards the point. If this attraction be uniform, that is, the same at all distances from the point, the body will move in a circle if one direction be given to the forward push. The case with which we are best acquainted is when the force decreases as the squares of the distances from the centre or point of attraction increase; that is, when the force is four times less at twice the distance, nine times less at thrice the distance, sixteen times less at four times the distance, and so on. A force of this kind acting on the body will make it move in an oval, a parabola, or an hyperbola, according to the amount or direction of the impulse, or forward push originally given; and there is one proportion of that force, which, if directed perpendicularly to the line in which the central force draws the body, will make it move round in a circle, as if it were a

stone tied to a string and whirled round the hand. The most usual proportions in nature are those which determine bodies to move in an oval or ellipse, the curve described by means of a cord fixed at both ends, in the way already explained. In this case, the point of attraction, the point towards which the body is drawn, will be nearer one end of the ellipse than the other, and the time the body will take to go round, compared with the time any other body would take, moving at a different distance from the same point of attraction, but drawn towards that point with a force which bears the same proportion to the distance, will bear a certain proportion, discovered by mathematicians, to the average distances of the two bodies from the point of common attraction. If you multiply the numbers expressing the times of going round, each by itself, the products will be to one another in the proportion of the average distances multiplied by itself, and that product again by the distance. Thus, if one body take two hours, and is five yards distant, the other, being ten yards off, will take something less than five hours and forty minutes.*

Now this is one of the most important truths in the whole compass of science; for it does so happen, that the force with which bodies fall towards the earth, or what is called their *gravity* (the power that draws or attracts them towards the earth), varies with the distance from the Earth's centre, ex-

* This is expressed mathematically by saying that the squares of the times are as the cubes of the distances. Mathematical language is not only the simplest and most easily understood of any, but the shortest also.

actly in the proportion of the squares, lessening as the distance increases ; at two diameters from the Earth's centre it is four times less than at one ; at three diameters, nine times less ; and so forth. It goes on lessening, but never is destroyed, even at the greatest distances to which we can reach by our observations, and there can be no doubt of its extending indefinitely beyond. But by astronomical observations made upon the motion of the heavenly bodies, upon that of the moon, for instance, it is proved that her movement is slower and quicker at different parts of her course, in the same manner as a body's motion on the earth would be slower and quicker, according to its distance from the point it was drawn towards, provided it was drawn by a force acting in the proportion to the squares of the distance, which we have frequently mentioned ; and the proportion of the time to the distance is also observed to agree with the rule above referred to. Therefore, she is shown to be attracted towards the Earth by a force that varies according to the same proportion in which gravity varies ; and she must consequently move in an ellipse round the Earth, which is placed in a point nearer the one end than the other of that curve. In like manner, it is shown that the Earth moves round the Sun in the same curve line, and is drawn towards the Sun by a similar force ; and that all the other planets in their courses, at various distances, follow the same rule, moving in ellipses, and being drawn towards the Sun by the same kind of power. Three of them have moons like the Earth, only more numerous ; for Ju-

Jupiter has four, Saturn seven, and Herschel six, so very distant that we cannot see them without the help of glasses ; but all those moons move round their principal planets, as ours does round the Earth, in ovals or ellipses ; while the planets, with their moons, move in their ovals round the Sun, like our own Earth with its moon.

But this power, which draws them all towards the Sun, and regulates their path and their motion round him, and which draws the moons towards the principal planets, and regulates their motion and path round those planets, is the same with the gravity by which bodies fall towards the earth, being attracted by it. Therefore the whole of the heavenly bodies are kept in their places, and wheel round the Sun, by the same influence or power that makes a stone fall to the ground.

It is usual to call the Sun, and the planets which, with their moons, move round him (eleven in number, including the four lately discovered and the one discovered by Herschel), the *Solar System* ; because they are a class of the heavenly bodies far apart from the innumerable Fixed Stars, and so near each other as to exert a perceptible influence on one another, and thus to be connected together.

The *Comets* belong to the same system, according to this manner of viewing the subject. They are bodies which move in elliptical paths, but far longer and narrower than the curves in which the Earth and the other planets, and their moons, roll. Our curves are not much less round than circles ; the paths of the comets are long and narrow, so as,

in many places, to be more nearly straight lines than circles. They differ from the planets and their moons in another respect ; they do not depend on the Sun for the light they give, as our Moon plainly does, being dark when the Earth comes between her and the Sun ; and as the other planets do ; those of them that are nearer the Sun than we are being dark when they come between us and him, and appearing to pass across his surface. But the comets give light always of themselves, being apparently vast bodies heated red hot by coming in their course far nearer the Sun than the nearest of the planets ever do. Their motion, when near the Sun, is much more rapid than that of the planets ; they approach him much nearer, retreat from him to much greater distances, and take much longer time in going round him than any of the planets do. Yet even these comets are subject to the same great law of gravitation which regulates the motions of the planets. Their year (the time they take to revolve) is in some cases 75, in others 135, in others 300 of our years ; their distance is a hundred times our distance when farthest off, and not a hundred and sixtieth of our distance when nearest the Sun ; their swiftest motion is above twelve times swifter than ours, although ours is a hundred and forty times swifter than a cannon ball's ; yet their path is a curve of the same kind with ours, though longer and flatter, differing in its formation only as one oval differs from another by the string you draw it with having the ends fixed at two points more distant from each other ; consequently the Sun, being in one

of those points, is much nearer the end of the path the comet moves in than he is near the end of our path. Their motion, too, follows the same rule, being swifter the nearer the Sun ; the attraction of the Sun for them varies according to the square of the distance, being four times less at twice the distance, nine times less at thrice, and so on ; and the proportion between the times of revolving and the distances is exactly the same in the case of those remote bodies, as in that of the Moon and the Earth. One law prevails over all, and regulates their motions as well as our own ; it is the gravity of the comets towards the Sun, and they, like our own Earth and Moon, wheel round him in boundless space, drawn by the same force, acting by the same rule, which makes a stone fall when dropped from the hand.

The more full and accurate our observations are upon those heavenly bodies, the better we find all their motions agreeing with this great doctrine ; although, no doubt, many things are to be taken into the account besides the force that draws them to the different centres. Thus, while the Moon is drawn by the Earth, and the Earth by the Sun, the Moon is also drawn directly by the Sun ; and while Jupiter is drawn by the Sun, so are his moons ; and both Jupiter and his moons are drawn by Saturn : nay, as this power of gravitation is quite universal, and as no body can attract or draw another without being itself drawn by that other, the Earth is drawn by the Moon, while the Moon is drawn by the Earth ; and the Sun is attracted by the planets which

he draws towards himself. These mutual attractions give rise to many deviations from the simple line of the ellipse, and produce many irregularities in the simple calculation of the times and motions of the bodies that compose the System of the Universe. But the extraordinary powers of investigation applied to the subject by the modern improvements in Mathematics, have enabled us at length to reduce even the greatest of the irregularities to order and system; and to unfold one of the most wonderful truths in all science, namely, that, by certain necessary consequences of the simple fact upon which the whole fabric rests, the proportion of the attractive forces to the distances at which it operates—all the irregularities which at first seemed to disturb the order of the system, and to make the appearances depart from the doctrine, are themselves subject to a certain fixed rule, and can never go beyond a particular point, but must begin to lessen when they have slowly reached that point, and must then lessen until they reach another point, when they begin again to increase, and so on for ever. Nay, so perfect is the arrangement of the whole system, and so accurately does it depend upon mathematical principles, that irregularities, or, rather, apparent deviations, have been discovered by mathematical reasoning before astronomers had observed them; and then their existence has been ascertained by observation, and found to agree precisely with the results of calculation.* Thus, the planets move in ovals, from grav-

* The application of Mathematics to Chymistry has already produced a great change in that science, and is calculated to

ity (the power that attracts them towards the Sun), combined with the original impulse they received forward; and the disturbing forces are continually varying the course of the curves or ovals, making them bulge out in the middle, as it were, on the sides, though in a very small proportion to the whole length of the ellipse. The oval thus bulging, its breadth increases by a very small quantity yearly and daily; and, after a certain large number of years, the bulging becomes as great as it ever can be; then the alteration takes a contrary direction, and the curve gradually flattens as it had bulged; till, in the same number of years which it took to bulge, it becomes as flat as it ever can be, and then it begins to bulge again, and so on for ever.

And so, too, of every other disturbance and irregularity in the system: what at first appears to be some departure from the rule, when more fully examined, turns out to be only a consequence of it, or the result of a more general arrangement springing from the principle of Gravitation; an arrangement of which the rule itself, and the apparent or supposed exception, both form parts.

produce still greater improvements. It may be almost certainly reckoned upon as the source of new discoveries, made by induction after the mathematical reasoning has given the suggestion. The learned reader will perceive that we allude to the beautiful doctrine of *Definite* or *Multiple Proportions*. To take an example: the probability of an oxide of arsenic being discovered is impressed upon us by the composition of arsenious and arsenic acids, in which the oxygen is as 2 to 3; and therefore we may expect to find a compound of the same base, with the oxygen as unity. The extraordinary action of chlorine and its compounds on light leads us to expect some farther discovery respecting its composition, perhaps respecting the matter of light.

The power of Gravitation, which thus regulates the whole system of the universe, is found to rule each member or branch of it separately. Thus it is demonstrated that the Tides of the ocean are caused by the gravitation which attracts the water towards the Sun and Moon; and the figure both of our Earth and of such of the other bodies as have a spinning motion round their axis, is determined by gravitation combined with that motion; they are all flattened towards the ends of the axis they spin upon, and bulge out towards the middle.

The great discoverer of the principle on which all these truths rest, Sir Isaac Newton (certainly by far the most extraordinary man that ever lived), concluded, by reasoning upon the nature of motion and matter, that this flattening must take place in our globe: every one before his time had believed the Earth to be a perfect sphere or globe, chiefly from observing the round shadow which it casts on the moon in eclipses; and it was many years after his death that the accuracy of his opinion was proved by measurements on the Earth's surface, and by the different weight and attraction of bodies at the equator, where it bulges, and at the poles, where it is flattened. The improvement of telescopes has enabled us to ascertain the same fact with respect to the planets Jupiter and Saturn.

Besides unfolding the general laws which regulate the motions and figures of the heavenly bodies forming our Solar System, Astronomy consists in calculations of the places, times, and eclipses of those bodies, and their moons or *satellites* (from a Latin

word signifying an *attendant*), and in observations of the Fixed Stars, which are innumerable assemblages of bodies, not moving round the Sun as our Earth and the other planets do, nor receiving the light they shine with from his light : but shining as the Sun and the Comets do, with a light of their own, and placed, to all appearance, immoveable, at immense distances from our world, that is, from our Solar System. Each of them is probably the sun of some other system like our own, composed of planets and their moons or satellites ; but so extremely distant from us, that they all are seen by us like one point of faint light, as you see two lamps, placed a few inches asunder, only like one when you view them a great way off. The number of the Fixed Stars is prodigious : even to the naked eye they are very numerous, about 3000 being thus visible ; but when the heavens are viewed through the telescope, stars become visible in numbers wholly incalculable : 2000 are discovered in one of the small collections of a few visible stars called *Constellations* ; nay, what appears to the naked eye only a light cloud, as the *Milky Way*, when viewed through the telescope proves to be an assemblage of innumerable Fixed Stars, each of them, in all likelihood, a sun and a system like the rest, though at an immeasurable distance from ours.

The size, and motions, and distances of the heavenly bodies are such as to exceed the power of ordinary imagination, from any comparison with the smaller things we see around us. The Earth's diameter is nearly 8000 miles in length ; but the

Sun's is above 880,000 miles, and the bulk of the Sun is above 1,300,000 times greater than that of the Earth. The planet Jupiter, which looks like a mere speck, from his vast distance, is nearly 1300 times larger than the Earth. Our distance from the Sun is above 95 millions of miles ; but Jupiter is 490 millions, and Saturn 900 millions of miles distant from the Sun. The rate at which the Earth moves round the Sun is 68,000 miles an hour, or 140 times swifter than the motion of a cannon ball ; and the planet Mercury, the nearest to the Sun, moves still quicker, nearly 110,000 miles an hour. We, upon the Earth's surface, besides being carried round the Sun, move round the Earth's axis by the rotary or spinning motion which it has ; so that every 24 hours we move in this manner near 14,000 miles, besides moving round the Sun above 1,600,000 miles. These motions and distances, however, prodigious as they are, seem as nothing compared to those of the comets, one of which, when farthest from the Sun, is 11,200 millions of miles from him ; and when nearest the Sun, flies at the amazing rate of 880,000 miles an hour. Sir Isaac Newton calculated its heat at 2000 times that of red-hot iron ; and that it would take thousands of years to cool. But the distance of the Fixed Stars is yet more vast ; they have been supposed to be 400,000 times farther from us than we are from the Sun, that is, 38 millions of millions of miles ; so that a cannon ball would take near nine millions of years to reach one of them, supposing there was nothing to hinder it from pursuing its course thither. As light takes

about eight minutes and a quarter to reach us from the Sun, it would be above six years in coming from one of those stars ; but the calculations of later astronomers prove some stars to be so far distant, that their light must take centuries before it can reach us ; so that every particle of light which enters our eyes left the star it comes from three or four hundred years ago.

Astronomers have, by means of their excellent glasses, aided by Geometry and calculation, been able to observe not only stars, planets, and their satellites, invisible to the naked eye, but to measure the height of mountains in the Moon, by observations of the shadows which those eminences cast on her surface ; and they have discovered volcanoes or burning mountains in the same body.

The tables which they have, by the like means, been enabled to form of the heavenly motions, are of great use in navigation. By means of the eclipses of Jupiter's satellites, and by the tables of the Moon's motions, we can ascertain the position of a ship at sea ; for the observation of the Sun's height at midday gives the *latitude* of the place, that is, its distance from the equinoctial or equator, the line passing through the middle of the Earth's surface, equally distant from both poles ; and these tables, with the observations of the satellites or moons, give the distance east and west of the observatory for which the tables are calculated—called the *longitude* of the place : consequently, the mariner can thus tell nearly in what part of the ocean he is, how far he has sailed from his port of departure, and how far

he must sail, and in what direction, to gain the port of his destination. The advantage of this knowledge is therefore manifest in the common affairs of life; but it sinks into insignificance compared with the vast extent of those views which the contemplations of the science afford, of numberless worlds filling the immensity of space, and all kept in their places, and adjusted in their prodigious motions, by the same simple principle, under the guidance of an all-wise and all-powerful Creator.

We have been considering the application of Dynamics to the motions of the heavenly bodies, which forms the science of *Physical Astronomy*. The application of Dynamics to the calculation, production, and direction of motion, forms the science of *Mechanics*, sometimes called *Practical Mechanics*, to distinguish it from the more general use of the word, which comprehends everything that relates to motion and force. The fundamental principle of the science, upon which it mainly depends, flows immediately from a property of the circle already mentioned, and which, perhaps, appeared at the moment of little value—that the lengths of circles are in proportion to their diameters. Observe how upon this simple truth nearly the whole of those contrivances are built, by which the power of man is increased, as far as solid matter assists him in extending it; and nearly the whole of those doctrines, too, by which he is enabled to explain the voluntary motions of animals, as far as these depend upon their own bodies. There can be nothing more instructive in showing the importance and fruitfulness of scientific truths,

however trivial and forbidding they may at first sight appear. For it is an immediate consequence of this property of the circle, that if a rod of iron, or beam of wood, or any other solid material, be placed on a point or pivot, so that it may move as the arms of a balance do round its centre, or a see-saw board does round its prop, the two ends will go through parts of circles, each proportioned to that arm of the beam to which it belongs ; the two circles will be equal if the pivot is in the centre or middle point of the beam ; but if it is nearer one end than the other, say three times, that end will go through a circular space or arch three times shorter than the circular space the other end goes through in the same time. If, then, the end of the long beam goes through three times the space, it must move with three times the swiftness of the short beam's end, since both move in the same time ; and, therefore, any force applied to the long end must overcome the resistance of three times that force applied at the opposite end, since the two ends move in contrary directions ; hence one pound placed at the long end would balance three placed at the short end. The beam we have been supposing is called a *Lever*, and the same rule must evidently hold for all proportions of the lengths of its arms. If, then, the lever be seventeen feet long, and the pivot or *fulcrum* (as it is called, from a Latin word signifying *support*) be a foot from one end, an ounce placed on the other end will balance a pound placed on the near end ; and the least additional weight, or the slightest push or pressure on the far end, so loaded, will make the pound weight on the other move

upward. If, instead of an ounce, we place upon the end of the long arm the short arm of a second beam or lever supported by a fulcrum, one foot from it, and then place the long arm of this second lever upon the short arm of a third lever, whose fulcrum is one foot from it; and if we put on the end of this third lever's long arm an ounce weight, that ounce will move upward a pound on the second lever's long arm, and this moving upward will cause the short arm to force downward sixteen pounds at the long end of the first lever, which will make the short end of the first lever move upward, though two hundred and fifty-six pounds be laid on it; the same thing continuing, a pound on the arm of the third lever will move a ton and three quarters on the short arm of the first lever; that is, will balance it, so that the slightest pressure with the finger, or a touch from a child's hand, will move as much as two horses can draw. The lever is called, on this account, a *mechanical power*; and there are five other mechanical powers, of most of which its properties form the foundation; indeed, they have all been resolved into combinations of levers. The pulley seems the most difficult to reduce under the principle of the lever. Thus the *wheel and axle* is only a lever moving round an axle, and always retaining the effect gained during every part of the motion, by means of a rope wound round the butt end of the axle; the spoke of the wheel being the long arm of the lever, and the half diameter of the axle its short arm. By a combination of levers, wheels, pulleys, so great an increase of force is obtained, that, but for the obstruc-

tion from friction and the resistance of the air, there could be no bounds to the effect of the smallest force thus multiplied ; and to this fundamental principle, Archimedes, one of the most illustrious mathematicians of ancient times, referred, when he boasted that, if he only had a pivot or fulcrum whereon he might rest his machinery, he could move the earth. Upon so simple a truth, assisted by the aid derived from other sources, rests the whole fabric of mechanical power, whether for raising weights, or cleaving rocks, or pumping up rivers from the bowels of the earth ; or, in short, performing any of those works to which human strength, even augmented by the help of the animals whom Providence has subdued to our use, would prove altogether inadequate.

The application of Dynamics to the pressure and motions of fluids, constitutes a science which receives different appellations according as the fluids are heavy and liquid, like water, or light and invisible, like air. In the former case it is called *Hydrodynamics*, from the Greek words signifying *water* and *power*, or *force* ; in the latter *Pneumatics*, from the Greek word signifying *breath* or *air* ; and Hydrodynamics is divided into *Hydrostatics*, which treats of the weight and pressure of liquids, from the Greek words for *balancing of water* ; and *Hydraulics*, which treats of their motion, from the Greek name for certain musical instruments played with *water* in *pipes*.

The discoveries to which experiments upon the pressure and motion of fluids, aided by mathematical reasoning, have led, are of the greatest impor-

tance, whether we regard their application to practical purposes, or their use for explaining the appearances in nature, or their singularity as the subjects of scientific contemplation. When it is found that the pressure of water, or any other liquid upon the surface that contains it, is not in the least degree proportioned to its bulk, but only to the height at which it stands, so that a long small pipe, containing a pound or two of the fluid, will give the pressure of twenty or thirty tons ; nay, of twice or thrice as much, if its length be increased and its bore lessened, without the least regard to the quantity of the liquid, we are not only astonished at so extraordinary and unexpected a property of matter, but we straightway perceive one of the great agents employed in the vast operations of nature, in which the most trifling means are used to work the mightiest effects. We likewise learn to guard against many serious mischiefs in our own works, and to apply safely and usefully a power calculated, according as it is directed, either to produce unbounded devastation, or to render the most beneficial service.

Nor are the discoveries relating to the Air less interesting in themselves, and less applicable to important uses. It is an agent, though invisible, as powerful as Water, in the operations both of nature and of art. Experiments of a simple and decisive nature show the amount of its pressure to be between 14 and 15 pounds on every square inch ; but, like all other fluids, it presses equally in every direction ; so that though, on one hand, there is a pressure downward of above 250 pounds, yet this

is exactly balanced by an equal pressure upward, from the air pressing round and getting below. If, however, the air on one side be removed, the whole pressure from the other acts unbalanced. Hence the ascent of water in pumps, which suck out the air from a barrel, and allow the pressure upon the water to force it up 32 or 33 feet, that body of water being equal to the weight of the atmosphere. Hence the ascent of the mercury in the barometer is only 28 or 29 inches, mercury being between 13 and 14 times heavier than water. Hence, too, the motion of the steam-engine; the piston of which, until the direct force of steam was applied, used to be pressed downward by the weight of the atmosphere from above, all air being removed below it by first filling it with steam, and then suddenly cooling and converting that steam into water, so as to leave nothing in the space it had occupied. Hence, too, the power which some animals possess of walking along the perpendicular surfaces of walls, and even the ceilings of rooms, by squeezing out the air between the inside of their feet and the wall, and thus being supported by the pressure of the air against the outside of their feet.

The science of *Optics* (from the Greek word for *seeing*), which teaches the nature of light, and of the sensation conveyed by it, presents, of itself, a field of unbounded extent and interest. To it the arts and the other sciences owe those most useful instruments which have enabled us at once to examine the minutest parts of the structure of animal and vegetable bodies, and to calculate the size and the

motions of the most remote of the heavenly bodies. But as an object of learned curiosity, nothing can be more singular than the fundamental truth discovered by the genius of Newton—that the light, which we call white, is, in fact, composed of all the colours, blended in certain proportions; unless, perhaps, it be that astonishing conjecture of his unrivalled sagacity, by which he described the inflammable nature of the diamond, and its belonging, against all appearance of probability, to the class of oily substances, from having observed that it stood among them, and far removed from all crystals, in the degree of its action upon light; a conjecture turned into certainty by discoveries made a century afterward.

To a man who, for original genius and strong natural sense, is not unworthy of being named after this illustrious sage, we owe the greater part of *Electrical* science. It treats of the peculiar substance, resembling both light and heat, which, by rubbing, is found to be produced in a certain class of bodies, as glass, wax, silk, amber; and to be conveyed easily or *conducted* through others, as wood, metals, water; and it has received the name of *Electricity*, from the Greek word for *amber*. Dr. Franklin discovered that this is the same matter which, when collected in the clouds, and conveyed from them to the earth, we call *lightning*; and whose noise, in darting through the air, is *thunder*. The observation of some movements in the limbs of a dead frog gave rise to the discovery of *Animal Electricity*, or *Galvanism*, as it was at first called

from the name of the discoverer ; and which has of late years given birth to improvements that have changed the face of chymical philosophy ; affording a new proof how few there are of the processes of nature incapable of repaying the labour we bestow in patiently and diligently examining them. It is to the results of the remark accidentally made upon the twitching in the frog's leg (not, however, hastily dismissed and forgotten, but treasured up and pursued through many an elaborate experiment and calculation), that we owe our acquaintance with the extraordinary metal, liquid like mercury, lighter than water, and more inflammable than phosphorus, which forms, when it burns by mere exposure to the air, one of the salts best known in commerce, and the principal ingredient in saltpetre.

In order to explain the nature and objects of those branches of Natural Science more or less connected with the mathematics, some details were necessary ; as without them it was difficult immediately to perceive their importance, and, as it were, relish the kind of instruction which they afford. But the same course need not be pursued with respect to the other branches. The value and interest of chymistry is at once perceived, when it is known to teach the nature of all bodies ; the relations of simple substances to heat and to one another, or their combinations together ; the composition of those which nature produces in a compound state ; and the application of the whole to the arts and manufactures. Some branches of philosophy, again, are chiefly useful and interesting to particular classes, as surgeons

and physicians. Others are easily understood by a knowledge of the principles of Mechanics and Chymistry, of which they are applications and examples ; as those which teach the structure of the earth and the changes it has undergone ; the motions of the muscles, and the structure of the parts of animals ; the qualities of animal and vegetable substances ; and that department of Agriculture which treats of soils, manure, and machinery. Other branches are only collections of facts, highly curious and useful indeed, but which any one who reads or listens, perceives as clearly, and comprehends as readily as the professed student. To this class belongs Natural History, in so far as it describes the habits of animals and plants, and its application to that department of Agriculture which treats of cattle and their management.

IV. APPLICATION OF NATURAL SCIENCE TO THE ANIMAL AND VEGETABLE WORLD.

BUT, for the purpose of further illustrating the advantages of Philosophy, its tendency to enlarge the mind, as well as to interest it agreeably, and afford pure and solid gratification, a few instances may be given of the singular truths brought to light by the application of Mathematical, Mechanical, and Chymical knowledge to the habits of animals and plants ; and some examples may be added of the more ordinary and easy, but scarcely less interesting observations made upon those habits, without the aid of the profounder sciences.

We may remember the curve line which mathe-

maticians call a Cycloid. It is the path which any point of a circle, moving along a plane, and round its centre, traces in the air ; so that the nail on the felly of a cart-wheel moves in a cycloid as the cart goes along, and as the wheel itself both turns round its axle and is carried along the ground. Now this curve has certain properties of a peculiar and very singular kind with respect to motion. One is, that if any body whatever moves in a cycloid by its own weight or swing, together with some other force acting upon it all the while, it will go through all distances of the same curve in exactly the same time ; and, accordingly, pendulums have sometimes been contrived to swing in such a manner that they shall describe cycloids, or curves very nearly cycloids, and thus move in equal times, whether they go through a long or a short part of the same curve. Again, if a body is to descend from any one point to any other, not in the perpendicular, by means of some force acting on it together with its weight, the line in which it will go the quickest of all will be the cycloid ; not the straight line, though that is the shortest of all lines which can be drawn between the two points ; nor any other curve whatever, though many are much flatter, and, therefore, shorter than the cycloid ; but the cycloid, which is longer than many of them, is yet, of all curved or straight lines which can be drawn, the one the body will move through in the shortest time. Suppose, again, that the body is to move from one point to another, by its weight and some other force acting together, but to go through a certain space, as a hundred yards ; the way it must take to do this, in

the shortest time possible, is by moving in a cycloid; or the length of a hundred yards must be drawn into a cycloid, and then the body will descend through the hundred yards in a shorter time than it could go the same distance in any other path whatever. Now it is believed that birds, as the eagle, which build in the rocks, drop or fly down from height to height in this course. It is impossible to make very accurate observations of their flight and path; but there is a general resemblance between the course they take and the cycloid, which has led ingenious men to adopt this opinion.

If we have a certain quantity of any substance, a pound of wood, for example, and would fashion it in the shape to take the least room, we must make a globe of it; it will, in this figure, have the smallest surface. But suppose we want to form the pound of wood, so that, in moving through the air or water, it shall meet with the least possible resistance; then we must lengthen it out for ever, till it becomes not only like a long-pointed pin, but thinner and thinner, longer and longer, till it is quite a straight line, and has no perceptible breadth or thickness at all. If we should dispose of the given quantity of matter, so that it shall have a certain length only, say a foot, and a certain breadth at the thickest part, say three inches, and move through the air or water with the smallest possible resistance which a body of those dimensions can meet, then we must form it into a figure of a peculiar kind, called the *Solid of least resistance*, because, of all the shapes that can be given to the body, its length and breadth remaining the

same, this is the one which will make it move with the least resistance through the air or water, or other fluid. A very difficult chain of mathematical reasoning, by means of the highest branches of algebra, leads to a knowledge of the curve, which, by revolving on its axis, makes a solid of this shape, in the same way that a circle, by so revolving, makes a sphere or globe ; and the curve certainly resembles closely the face or head part of a fish. Nature, therefore (by which we always mean the Divine Author of nature), has fashioned these fishes so, that, according to mathematical principles, they swim the most easily through the element they live and move in.*

Suppose, upon the face part of one of these fishes, a small insect were bred, endowed with faculties sufficient to reason upon its condition, and upon the motion of the fish it belonged to, but never to have discovered the whole size and shape of the face part ; it would certainly complain of the form as clumsy, and fancy that it could have made the fish so as to move with less resistance. Yet, if the whole shape were disclosed to it, and it could discover the principle on which that shape was preferred, it would at once perceive, not only that what seemed clumsy was skillfully contrived, but that, if any other shape whatever had been taken, there would have been an error committed ; nay, *that there must of necessity* have been an error ; and that the very best possible arrange-

* The feathers of the wings of birds are found to be placed at the *best possible* angle for helping on the bird by their action on the air.

ment had been adopted. So it may be with man in the universe, where, seeing only a part of the great system, he fancies there is evil ; and yet, if he were permitted to survey the whole, what had seemed imperfect might appear to be necessary for the general perfection, insomuch that any other arrangement, even of that seemingly imperfect part, must needs have rendered the whole less perfect. The common objection is, that what seems evil *might have* been avoided ; but in the case of the fish's shape, it *could not* have been avoided.

It is found by optical inquiries, that the particles or rays of light, in passing through transparent substances of a certain form, are bent to a point where they make an image or picture of the shining bodies they come from, or of the dark bodies they are reflected from. Thus, if a pair of spectacles be held between a candle and the wall, they make two images of the candle upon it ; and if they be held between the window and a sheet of paper when the sun is shining, they make a picture on the paper of the houses, trees, fields, sky, and clouds. The eye is found to be composed of several natural magnifiers, which make a picture on a membrane at the back of it, and from this membrane there goes a nerve to the brain, conveying the impression of the picture, by means of which we see. Now white light was discovered by Newton to consist of differently-coloured parts, which are differently bent in passing through transparent substances, so that the lights of several colours come to a point at different distances, and thus create an indistinct image at any

one distance. This was long found to make our telescopes imperfect, insomuch that it became necessary to make them of reflectors or mirrors, and not of magnifying glasses, the same difference not being observed to affect the reflection of light. But another discovery was, about fifty years afterward, made by Mr. Dollond—that, by combining different kinds of glass in a compound magnifier, the difference may be greatly corrected; and on this principle he constructed his telescopes. It is found, too, that the different natural magnifiers of the eye are combined upon a principle of the same kind. Thirty years later, a third discovery was made by Mr. Blair, of the greatly superior effect which combinations of different liquids have in correcting the imperfection; and, most wonderful to think, when the eye is examined, we find it consists of different liquids, acting naturally upon the same principle, which was thus recently found out in Optics, by many ingenious mechanical and chymical experiments.

Again, the point to which any magnifier collects the light is more or less distant as the magnifier is flatter or rounder, so that a small globe of glass or any transparent substance makes a microscope. And this property of light depends upon the nature of lines, and is purely of a mathematical nature, after we have once ascertained by experiment that light is bent in a certain way when it passes through transparent bodies. Now birds flying in the air, and meeting with many obstacles, as branches and leaves of trees, require to have their eyes sometimes as flat as possible for protection; but sometimes as round as pos-

sible, that they may see the small objects, flies and other insects, which they are chasing through the air, and which they pursue with the most unerring certainty. This could only be accomplished by giving them a power of suddenly changing the form of their eyes. Accordingly, there is a set of hard scales placed on the outer coat of their eye, round the place where the light enters; and over these scales are drawn the muscles or fibres by which motion is communicated; so that, by acting with these muscles, the bird can press the scales and squeeze the natural magnifier of the eye into a round shape when it wishes to follow an insect through the air, and can relax the scales in order to flatten the eye again when it would see a distant object, or move safely through leaves and twigs. This power of altering the shape of the eye is possessed by birds of prey in a very remarkable degree. They can thus see the smallest objects close to them, and can yet discern larger bodies at vast distances, as a carcass stretched upon the plain, or a dying fish afloat on the water.

A singular provision is made for keeping the surface of the bird's eye clean—for wiping the glass of the instrument, as it were—and also for protecting it, while rapidly flying through the air and through thickets, without hindering the sight. Birds are, for these purposes, furnished with a third eyelid, a fine membrane or skin, which is constantly moved very rapidly over the eyeball by two muscles placed in the back of the eye. One of the muscles ends in a loop, the other in a string which goes through the loop, and is fixed in the corner of the membrane, to

pull it backward and forward. If you wish to draw a thing towards any place with the least force, you must pull directly in the line between the thing and the place ; but if you wish to draw it as quickly as possible, and with the most convenience, and do not regard the loss of force, you must pull obliquely, by drawing it in two directions at once. Tie a string to a stone, and draw it straight towards you with one hand ; then make a loop on another string, and, running the first through it, draw one string in each hand, not towards you, but sideways, till both strings are stretched in a straight line ; you will see how much more easily the stone moves quickly than it did before, when pulled straight forward. Again, if you tie strings to the two ends of a rod or slip of card in a running groove, and bring them to meet and pass through a ring or hole, for every inch in a straight line that you draw both together below the ring, the rod will move onward two. Now this is proved by mathematical reasoning to be the necessary consequence of force applied obliquely : there is a loss of power, but a great gain in velocity and convenience. This is the thing required to be gained in the third eyelid, and the contrivance is exactly that of a string and a loop, moved each by a muscle, as the two strings are by the hands in the cases we have been supposing.

A third eyelid of the same kind is found in the horse, and called the *haw* ; it is moistened with a pulpy substance (or mucilage) to take hold of the dust on the eyeball, and wipe it clean off ; so that the eye is hardly ever seen with anything upon it, though

greatly exposed from its size and posture. The swift motion of the haw is given to it by a gristly elastic substance, placed between the eyeball and the socket, and striking obliquely, so as to drive out the haw with great velocity over the eye, and then let it come back as quickly. Ignorant persons, when this haw is inflamed from cold, and swells so as to appear, which it never does in a healthy state, often mistake it for an imperfection, and cut it off: so nearly do ignorance and cruelty produce the same mischief.

If any quantity of matter, as a pound of wood or iron, is fashioned into a rod of a certain length, say one foot, the rod will be strong in proportion to its thickness; and if the figure is the same, that thickness can only be increased by making it hollow. Therefore hollow rods or tubes, of the same length and quantity of matter, have more strength than solid ones. This is a principle so well understood now, that engineers make their axles and other parts of machinery hollow, and therefore stronger, with the same weight, than they would be if thinner and solid. Now the bones of animals are all more or less hollow; and are therefore stronger with the same weight and quantity of matter than they otherwise would be. But birds have the largest bones in proportion to their weight; their bones are more hollow than those of animals which do not fly; and, therefore, they have the needful strength without having to carry more weight than is absolutely necessary. Their quills derive strength from the same construction. They possess another peculiarity to help their flight.

No other animals have any communication between the air-vessels of their lungs and the hollow parts of their bodies ; but birds have it, and by this means they can blow out their bodies as we do a bladder, and thus become lighter when they would either make their flight towards the ground slower, or rise more swiftly, or float more easily in the air ; while, by lessening their bulk and closing their wings, they can drop more speedily if they wish to chase or to escape. Fishes possess a power of the same kind, though not by the same means. They have *air-bladders* in their bodies, and can puff them out or press them closer at pleasure ; when they want to rise in the water, they fill out the bladder, and this lightens them : when they would sink, they squeeze the bladder, pressing the air into a smaller space, and this makes them heavier. If the bladder breaks, the fish remains at the bottom, and can be held up only by the most laborious exertions of the fins and tail. Accordingly, flat fish, as skaits and flounders, which have no air-bladders, seldom rise from the bottom, but are found lying on banks in the sea, or at the bottom of rivers.

If you have a certain space, as a room, to fill up with closets or little cells, all of the same size and shape, there are only three figures which will answer, and enable you to fill the room without losing any space between the cells ; they must either be squares, or figures of three equal sides, or figures of six equal sides. With any other figures whatever, space would be lost between the cells. This is evident upon considering the matter ; and it is proved by mathemat-

ical reasoning. The six-sided figure is by far the most convenient of those three shapes, because its corners are flatter, and any round body placed in it has therefore more space, less room being lost in the corners. This figure, too, is the strongest of the three; any pressure from without or from within will hurt it least, as it has something of the strength of an arch. A round figure would be still stronger, but then room would be lost between the circles, whereas with the six-sided figure none is lost. Now it is a most remarkable fact, that *bees* build their cells exactly in this shape, and thereby save both room and materials beyond what they could save if they built in any other shape whatever. They build in the very best possible shape for their purpose, which is to save all the room and all the wax they can. So far as to the shape of the walls of each cell; but the roof and floor, or top and bottom, are built on equally true principles. It is proved by mathematicians, that, to give the greatest strength and save the most room, the roof and floor must be made of three square planes meeting in a point; and they have farther proved, by a demonstration belonging to the highest parts of Algebra, that there is one particular angle or inclination of those planes to each other where they meet, which makes a greater saving of materials and of work than any other inclination whatever could possibly do. Now the bees actually make the tops and bottoms of their cells of three planes meeting in a point; and the inclinations or angles at which they meet are precisely those found out by the mathematician to be the best possible for saving wax

and work.* Who would dream of the bee knowing the highest branch of the Mathematics—the fruit of Newton's most wonderful discovery—a result, too, of which he was himself ignorant, one of his most celebrated followers having found it out in a later age? This little insect works with a truth and correctness which are perfect, and according to principles at which man has arrived only after ages of slow improvement in the most difficult branch of the most difficult science. But to the Mighty and All-wise Creator, who made the insect and the philosopher, bestowing reason on the latter, and giving the former to work without it—to Him all truths are known from all eternity, with an intuition that mocks even the conceptions of the sagest of human kind.

It may be recollected, that when the air is exhausted or sucked out of any vessel, there is no longer the force necessary to resist the pressure of the air on the outside; and the sides of the vessel are therefore pressed inward with violence; a flat glass would thus be broken, unless it were very thick; a round one, having the strength of an arch, would resist better; but any soft substance, as leather or skin, would be crushed or squeezed together at once. If the air was only sucked out slowly, the squeezing

* Koenig, pupil of Bernouilli, and Maclaurin, proved, by very refined investigations, carried on with the aid of the fluxional calculus, that the obtuse angle must be $109^{\circ} 28'$, and the acute $70^{\circ} 32'$, to save the most wax and work possible. Maraldi found, by actual measurement, that the angles are *about* 110° and 70° . These angles never vary in any place; and it is scarcely less singular, that the breadths of all bees' cells are everywhere precisely the same, the drone or male cells being 5-18ths, and the worker or female cells 13-60ths of an inch in breadth, and this in all countries and times.

would be gradual ; or, if it were only half sucked out, the skin would only be partly squeezed together. This is the process by which *bees* reach the fine dust and juices of hollow flowers, like the honeysuckle, and some kinds of long foxglove, which are too narrow for them to enter. They fill up the mouth of the flower with their bodies, and suck out the air, or, at least, a large part of it ; this makes the soft sides of the flower close, and squeezes the dust and juice towards the insect as well as a hand could do if applied to the outside.

We may remember this pressure or weight of the atmosphere, as shown by the barometer, and the sucking-pump. Its weight is near fifteen pounds on every square inch, so that if we could entirely squeeze out the air between our two hands, they would cling together with a force equal to the pressure of double this weight, because the air would press upon both hands ; and if we could contrive to suck or squeeze out the air between one hand and the wall, the hand would stick fast to the wall, being pressed on it with the weight of above two hundred weight, that is, near fifteen pounds on every square inch of the hand. Now, by a late most curious discovery of Sir Everard Home, the distinguished anatomist, it is found that this is the very process by which *flies*, and other insects of a similar description, are enabled to walk up perpendicular surfaces, however smooth, as the sides of walls and panes of glass in windows, and to walk as easily along the ceiling of a room with their bodies downward and their feet over head. Their feet, when examined by a

microscope, are found to have flat skins or flaps, like the feet of web-footed animals, as ducks and geese ; and they have, by means of strong folds, the power of drawing the flap close down upon the glass or wall they walk on, and thus squeezing out the air completely, so as to make a vacuum between the foot and the glass or wall. The consequence of this is, that the air presses the foot on the wall with a very considerable force compared with the weight of the insect ; for if its feet are to its body in the same proportion as ours are to our bodies, since we could support by a single hand on the ceiling of a room (provided it made a vacuum) more than our whole weight, namely, a weight of above fifteen stone, the insect can easily move on four feet in the same manner, by help of the vacuum made under its feet.

It has likewise been found that some of the larger *sea-animals* are, by the same construction, only upon a greater scale, enabled to climb the perpendicular and smooth surfaces of the ice-hills among which they live. Some kinds of *lizard* have a like power of climbing, and of creeping with their bodies downward along the ceiling of a room ; and the means by which they are enabled to do so are the same. In the large feet of those animals, the contrivance is easily observed, of the toes and muscles, by which the skin of the foot is pinned down, and the air excluded in the act of walking or climbing ; but it is the very same, only upon a larger scale, with the mechanism of a fly's or a butterfly's foot ; and both operations, the climbing of the seahorse on the ice, and the creeping of the fly on the window or the ceil-

ing, are performed by exactly the same power, the weight of the atmosphere, which causes the quicksilver to stand in the weather-glass, the wind to whistle through a keyhole, and the piston to descend in an oldfashioned steam-engine.

Although philosophers are not agreed as to the peculiar action which light exerts upon vegetation, and there is even some doubt respecting the decomposition of air and water during that process, one thing is undeniable—the necessity of light to the growth and health of plants; without it they have neither colour, taste, nor smell; and, accordingly, they are, for the most part, so formed as to receive it at all times when it shines on them. Their cups, and the little assemblages of their leaves before they sprout, are found to be more or less affected by the light, so as to open and receive it. In several kinds of plants this is more evident than in others; their flowers close entirely at night, and open in the day. Some constantly turn round towards the light, following the sun, as it were, while he makes, or seems to make, his revolution, so that they receive the greatest quantity possible of his rays. Thus clover in a field follows the apparent course of the sun. But all leaves of plants turn to the sun, place them how you will, light being essential to their thriving.

The lightness of inflammable gas is well known. When bladders of any size are filled with it, they rise upward and float in the air. Now it is a most curious fact, ascertained by Mr. Knight, that the fine dust, by means of which plants are impregnated one from another, is composed of very small globules

filled with this gas—in a word, of small air-balloons. These globules thus float from the male plant through the air, and, striking against the females, are detained by a glue prepared on purpose to stop them, which no sooner moistens the globules than they explode, and their substance remains, the gas flying off which enabled them to float. A provision of a very simple kind is also, in some cases, made to prevent the male and female blossoms of the same plant from breeding together, this being found to hurt the breed of vegetables, just as breeding in and in spoils the race of animals. It is contrived that the dust shall be shed by the male blossom before the female of the same plant is ready to be affected by it; so that the impregnation must be performed by the dust of some other plant, and in this way the breed be crossed. The light gas with which the globules are filled is most essential to the operation, as it conveys them to great distances. A plantation of yew-trees has been known in this way to impregnate another several hundred yards off.

The contrivance by which some creeper plants are enabled to climb walls and fix themselves, deserves attention. The *Virginia creeper* has a small tendril, ending in a claw, each toe of which has a knob, thickly set with extremely small bristles; they grow into the invisible pores of the wall, and, swelling, stick there as long as the plant grows, and prevent the branch from falling; but when the plant dies, they become thin again and drop out, so that the branch falls down.

The *Vanilla* plant of the West Indies climbs

round trees likewise by means of tendrils ; but when it has fixed itself, the tendrils drop off, and leaves are formed.

It is found by chymical experiments that the juice which is in the stomachs of animals (called the *gastric* juice, from a Greek word signifying *the belly*) has very peculiar properties. Though it is, for the most part, a tasteless, clear, and seemingly very simple liquor, it nevertheless possesses extraordinary powers of dissolving substances which it touches or mixes with ; and it varies in different classes of animals. In one particular, it is the same in all animals ; it will not attack living matter, but only dead ; the consequence of which is, that its powers of eating away and dissolving are perfectly safe to the animals themselves, in whose stomachs it remains without hurting them. The juice differs in different animals, according to the food on which they subsist ; thus, in birds of prey, as kites, hawks, owls, it only acts upon animal matter, and does not dissolve vegetables. In other birds, and in all animals feeding on plants, as oxen, sheep, hares, it dissolves vegetable matter, as grass, but will not touch flesh of any kind. This has been ascertained by making them swallow balls with meat in them, and several holes drilled through to let the gastric juice reach the meat ; no effect was produced upon it. We may farther observe, that there is a most curious and beautiful correspondence between this juice in the stomachs of different animals and the other parts of their bodies, connected with the important operations of eating and digesting their food. The use of the juice is

plainly to convert what they eat into a fluid, from which, by various other processes, all their parts, blood, bones, muscles, &c., are afterward formed. But the food is first of all to be obtained, and then prepared by bruising for the action of the juice. Now birds of prey have instruments, their claws and beaks, for tearing and devouring their food (that is, animals of various kinds), but those instruments are useless for picking up and crushing seeds; accordingly, they have a gastric juice which dissolves the animals they eat; while birds, which have only a beak fit for pecking and eating seeds, have a juice that dissolves seeds and not flesh. Nay, more, it is found that the seeds must be bruised before the juice will dissolve them: this you find by trying the experiment in a vessel with the juice; and, accordingly, the birds have a gizzard, and animals which graze have flat teeth, which grind and bruise their food before the gastric juice is to act upon it.

We have seen how wonderfully the *bee* works, according to rules discovered by man thousands of years after the insect had been following them with perfect accuracy. The same little animal seems to be acquainted with principles of which we are still ignorant. We can, by crossing, vary the forms of cattle with astonishing nicety; but we have no means of altering the nature of an animal once born by means of treatment and feeding. This power, however, is undeniably possessed by the bees. When the queen bee is lost by death or otherwise, they choose a grub from among those which are born for workers; they make three cells into one, and, placing the grub there,

they build a tube round it ; they afterward build another cell of a pyramidal form, into which the grub grows ; they feed it with peculiar food, and tend it with extreme care. It becomes, when transformed from the worm to the fly, not a worker, but a queen bee.

These singular insects resemble our own species in one of our worse propensities, the disposition to war ; but their attention to their sovereign is equally extraordinary, though of a somewhat capricious kind. In a few hours after their queen is lost, the whole hive is in a state of confusion. A singular humming is heard, and the bees are seen moving all over the surface of the combs with great rapidity. The news spreads quickly, and when the queen is restored, quiet immediately succeeds. But if another queen is put upon them, they instantly discover the trick, and, surrounding her, they either suffocate or starve her to death. This happens if the false queen is introduced within a few hours after the first is lost or removed ; but if twenty-four hours have elapsed, they will receive any queen, and obey her.

The labours and the policy of the *ants* are, when closely examined, still more wonderful, perhaps, than those of the *bees*. Their nest is a city, consisting of dwelling-places, halls, streets, and squares into which the streets open. The food they principally like is the honey which comes from another insect found in their neighbourhood, and which they, generally speaking, bring home from day to day as they want it. Late discoveries have shown that they do not eat grain, but live almost entirely on animal food

and this honey. Some kinds of ant have the foresight to bring home the insects on whose honey they feed, and keep them in particular cells, where they guard them to prevent their escaping, and feed them with proper vegetable matter, which they do not eat themselves. Nay, they obtain the eggs of those insects, and superintend their hatching, and then rear the young insect until he becomes capable of supplying the desired honey. They sometimes remove them to the strongest parts of their nest, where there are cells apparently fortified for protecting them from invasion. In those cells the insects are kept to supply the wants of the whole of the ants which compose the population of the city. It is a most singular circumstance in the economy of nature, that the degree of cold at which the ant becomes torpid is also that at which this insect falls into the same state. It is considerably below the freezing point ; so that they require food the greater part of the winter ; and if the insects on which they depend for food were not kept alive during the cold in which the ants can move about, the latter would be without the means of subsistence.

How trifling soever this little animal may appear in our climate, there are few more formidable creatures than the ant of some tropical countries. A traveller who lately filled a high station in the French government, Mr. Malouet, has described one of their cities ; and, were not the account confirmed by various testimonies, it might seem exaggerated. He observed at a great distance what seemed a lofty structure, and was informed by his guide that it con-

sisted of an ant-hill, which could not be approached without danger of being devoured. Its height was from fifteen to twenty feet, and its base thirty or forty feet square. Its sides inclined like the lower part of a pyramid, the point being cut off. He was informed that it became necessary to destroy these nests by raising a sufficient force to dig a trench all round, and fill it with fagots, which were afterward set on fire; and then, battering with cannon from a distance, to drive the insects out and make them run into the flames. This was in South America; and African travellers have met with them in the same formidable numbers and strength.

The older writers of books upon the habits of some animals abound with stories which may be of doubtful credit. But the facts now stated respecting the ant and bee may be relied on as authentic. They are the result of very late observations, and experiments made with great accuracy by several most worthy and intelligent men; and the greater part of them have the confirmation arising from more than one observer having assisted in the inquiries.* The habits of *beavers* are equally well authenticated; and, being more easily observed, are vouched by a greater number of witnesses. These animals, as if to enable them to live and move either on land or water, have two webfeet like those of ducks or water-dogs, and two like those of land an-

* A singular circumstance occasioned this in the case of Mr. Huber, by far the most eminent of these naturalists: he was quite blind, and performed all his experiments by means of assistants.

imals. When they wish to construct a dwelling-place, or rather city (for it serves the whole body), they choose a level ground with a stream running through it; they then dam up the stream so as to make a pond, and perform the operation as skilfully as we could ourselves. Next they drive into the ground stakes of five or six feet long in rows, wattle each row with twigs, and puddling or filling the interstices with clay, which they ram close in, so as to make the whole solid and water-tight. This dam is likewise shaped on the truest principles; for the upper side next the water slopes, and the side below is perpendicular; the base of the dam is ten or twelve feet thick; the top or narrow part two or three, and it is sometimes as long as one hundred feet.* The pond being thus formed and secured, they make their houses round the edge of it; they are cells, with vaulted roofs, and upon piles: they are made of stones, earth, and sticks; the walls are two feet thick, and plastered as neatly as if the

* If the base is twelve, and the top three feet thick, and the height six feet, the face must be the side of a right-angled triangle, whose height is eight feet. This would be the exact proportion which there ought to be, upon mathematical principles, to give the greatest resistance possible to the water in its tendency to turn the dam round, provided the materials of which it is made were lighter than water in the proportion of 44 to 100. But the materials are probably more than twice as heavy as water, and the form of so flat a dike is taken, in all likelihood, in order to guard against a more imminent danger, that of the dam being carried away by being shoved forward. We cannot calculate what the proportions are which give the greatest possible resistance to this tendency, without knowing the tenacity of the materials, as well as their specific gravity. It may very probably be found, that the construction is such as to secure it the most completely against the two pressures at the same time.

trowel had been used. Sometimes they have two or three stories for retreating to in case of floods ; and they always have two doors, one towards the water, and one towards the land. They keep their winter provisions in stores, and bring them out to use ; they make their beds of moss ; they live on the bark of trees, gums, and crawfish. Each house holds from twenty to thirty, and there may be from ten to twenty-five houses in all. Some of their communities are larger than others, but there are seldom fewer than two or three hundred inhabitants. In working, they all bear their shares ; some gnaw the trees and branches with their teeth to form stakes and beams ; others roll the pieces to the water ; others, diving, make holes with their teeth to place the piles in ; others collect and carry stones and clay ; others beat and mix the mortar ; and others carry it on their broad tails, and with these beat it and plaster it. Some superintend the rest, and make signals by sharp strokes with their tail, which are carefully attended to ; the beavers hastening to the place where they are wanted to work, or to repair any hole made by the water, or to defend themselves or make their escape when attacked by an enemy.

The fitness of different animals, by their bodily structure, to the circumstances in which they are found, presents an endless subject of curious inquiry and pleasing contemplation. Thus the *camel*, which lives in sandy deserts, has broad, spreading hoofs to support him on the loose soil ; and an apparatus in his body by which water is kept for many

days, to be used when no moisture can be had. As this would be useless in the neighbourhood of streams or wells, and as it would be equally so in the desert where no water is to be found, there can be no doubt that it is intended to assist in journeying across the sands from one watered spot to another. There is a singular and beautiful provision made in this animal's foot, for enabling it to sustain the fatigue of journeys under the pressure of its great weight. Besides the yielding of the bones and ligaments, or bindings, which gives elasticity to the foot of the deer and other animals, there is in the camel's foot, between the horny sole and the bones, a cushion, like a ball, of soft matter, almost fluid, but in which there is a mass of threads, extremely elastic, interwoven with the pulpy substance. The cushion thus easily changes its shape when pressed, yet it has such an elastic spring, that the bones of the foot press on it uninjured by the heavy body which they support, and this huge animal steps as softly as a cat.

Nor need we flee to the desert in order to witness an example of skilful structure: the limbs of the *horse* display it strikingly. The bones of the foot are not placed directly under the weight; if they were in an upright position they would make a firm pillar, and every motion would cause a shock. They are placed slanting or oblique, and tied together by an elastic binding on their lower surfaces, so as to form springs as exact as those which we make of leather and steel for carriages. Then the flatness of the hoof which stretches out on each side, and the

frog coming down in the middle between the quarters, adds greatly to the elasticity of the machine. Ignorant of this, ill-informed farriers nail the shoe in such a manner as to fix the quarters, and cause permanent contraction of the bones, ligaments, and hoof—so that the elasticity is destroyed ; every step is a shock, inflammation and lameness ensue.*

The *reindeer* inhabits a country covered with snow the greater part of the year. Observe how admirably its hoof is formed for going over that cold and light substance, without sinking into it or being frozen. The under side is covered entirely with hair, of a warm and close texture ; and the hoof altogether is very broad, acting exactly like the snow-shoes which men have constructed for giving them a larger space to stand on than their feet, and thus avoid sinking. Moreover, the deer spreads the hoof as wide as possible when it touches the ground ; but, as this breadth would be inconvenient in the air, by occasioning a greater resistance while he is moving along, no sooner does he lift the hoof than the two parts into which it is cloven fall together, and so lessen the surface exposed to the air, just as we may recollect the birds doing with their bodies and wings. The shape and structure of the hoof is also well adapted to scrape away the snow, and enable the animal to get at the particular kind of moss (or *lichen*) on which he feeds. This plant, unlike others, is in its full growth during the winter season ; and the

* Mr. Bracey Clark has contrived an expanding shoe, which, by a joint in front, opens and contracts, so as to obviate the evils of the common process.

reindeer accordingly thrives from its abundance, at the season of his greatest use to man, notwithstanding the unfavourable effects of extreme cold upon the animal system.

There are some insects, of which the males have wings, and the females are grubs or worms. Of these, the *glow-worm* is the most remarkable : it is the female ; and the male is a fly, which would be unable to find her out, creeping as she does in the dark lanes, but for the shining light which she gives to attract him.

There is a singular fish found in the Mediterranean, called the *Nautilus*, from its skill in navigation. The back of its shell resembles the hulk of a ship ; on this it throws itself, and spreads two thin membranes to serve for two sails, paddling itself on with its feet or feelers as oars.

The *ostrich* lays and hatches her eggs in the sands ; her form being ill adapted for sitting on them, she has a natural oven furnished by the sand and the strong heat of the sun. The *cuckoo* is known to build no nest for herself, but to lay in the nests of other birds ; but late observations show that she does not lay indiscriminately in the nests of all birds ; she only chooses the nests of those which have bills of the same kind with herself, and therefore feed on the same kind of food. The *duck*, and other birds breeding in muddy places, have a peculiar formation of the bill ; it is both made so as to act like a strainer, separating the finer from the grosser parts of the liquid, and it is more furnished with nerves near the point than the bills of birds which feed on substan-

ces more exposed to the light ; so that, being more sensitive, it serves better to grope in the dark stream for food. The bill of the *snipe* is covered with a curious network of nerves for the same purpose ; but the most singular provision of the kind is observed in a bird called the *toucan*, or *egg-sucker*, which chiefly feeds on the eggs found in birds' nests, and in countries where these are very deep and dark. Its bill is broad and long ; when examined, it appears completely covered with branches of nerves in all directions ; so that, by groping in a deep and dark nest, it can feel its way as accurately as the finest and most delicate finger could. Almost all kinds of birds build their nests of materials found where they inhabit, or use the nests of other birds ; but the *swallow of Java* lives in rocky caverns on the sea, where there are no materials at all for the purpose of building. It is, therefore, so formed as to secrete in its body a kind of slime, with which it makes a nest, much prized as a delicate food in Eastern countries.*

Plants, in many remarkable instances, are provided for by equally wonderful and skilful contrivances. There is one, the *muscipula*, *flytrap* or *flycatcher*, which has small prickles in the inside of two leaves or half leaves, joined by a hinge ; a juice or sirup is provided on their inner surface, which acts as a

* It seems not yet to be settled whence the material is derived with which these birds build their nests. While some naturalists suppose it to be a mucus secreted by a peculiar apparatus of glands in the bird itself, others are of the opinion that it consists of a particular kind of plant, or of polypi, &c., gathered from the sea.—See Natural History of Birds, p. 98, Harpers' Family Library.

bait to allure flies. There are several small spines or prickles standing upright in this sirup, and upon the only part of each leaf that is sensitive to the touch. When the fly, therefore, settles upon this part, its touching, as it were, the spring of the trap, occasions the leaves to shut, and kill and squeeze the insect; whose juices, and the air arising from their rotting, serve as food to the plant.

In the West Indies and other hot countries of South America, where rain sometimes does not fall for a great length of time, a kind of plant called the *wildpine* grows upon the branches of the trees, and also on the bark of the trunk. It has hollow or bag-like leaves, so formed as to make little reservoirs of water, the rain falling into them through channels which close at the top when full, and prevent it from evaporating. The seed of this useful plant has small floating threads, by which, when carried through the air, it catches any tree in the way, and falls on it and grows. Wherever it takes root, though on the under side of a bough, it grows straight upward, otherwise the leaves would not hold water. It holds in one leaf from a pint to a quart; and although it must be of great use to the trees it grows on, to birds and other animals, its use is even greater. "When we find these pines," says Dampier, the famous navigator, "we stick our knives into the leaves just above the root, and the water gushing out, we catch it in our hats, as I myself have frequently done, to my great relief."

Another tree, called the *water-with*, in Jamaica, has similar uses; it is like a vine in size and shape,

and, though growing in parched districts, is yet so full of clear sap or water, that, by cutting a piece two or three yards long, and merely holding it to the mouth, a plentiful draught is obtained. In the East there is a plant of somewhat the same kind, called the *bejuco*, which grows near other trees and twines round them, with its end hanging downward, but so full of juice that, on cutting it, a good stream of water spouts from it; and this, not only by the stalk touching the tree so closely must refresh it, but affords a supply to animals, and to the weary herdsman on the mountains. Another plant, the *nepenthes distillatoria*, is found in the same regions, with a yet more singular structure. It has natural mugs or tankards hanging from its leaves, and holding each from a pint to a quart of very pure water. Two singular provisions are to be marked in this vegetable. There grows over the mouth of the tankard a leaf nearly its size and shape, like a lid or cover, which prevents evaporation from the sun's rays; and the water that fills the tankard is perfectly sweet and clear, although the ground in which the plant grows is a marsh of the most muddy and unwholesome kind. The process of vegetation filtrates or distils the liquid, so as to produce from the worst the purest water.* The *palo de Vaca*, or cowtree, grows in South America, upon the most dry and rocky soil, and in a climate where for months not a drop of rain falls. On piercing the trunk, however,

* A specimen of this curious plant, though of a small size, is to be found in the fine collection at Wentworth, reared by Mr. Cooper.

a sweet and nourishing milk is obtained, which the natives gladly receive in large bowls. If some plants thus furnish drink where it might least be expected, others prepare, as it were, in the desert, the food of man in abundance. A single *tapioca*-tree is said to afford from its pith the whole sustenance of several men for a season.

V. ADVANTAGES AND PLEASURES OF SCIENCE.

After the many instances or samples which have now been given of the nature and objects of Natural Science, we might proceed to a different field, and describe in the same way the other grand branch of human knowledge : that which teaches the properties or habits of *mind* ; the *intellectual faculties* of man, or the powers of his understanding, by which he perceives, imagines, remembers, and reasons ; his *moral faculties*, or the feelings and passions which influence him ; and, lastly, as a conclusion or result drawn from the whole, his *duties* both towards himself as an individual, and towards others as a member of society ; which last head opens to our view the whole doctrines of *political science*, including the nature of *governments*, of *policy*, and, generally, of *laws*. But we shall abstain at present from entering at all upon this field, and shall now take up the subject more particularly pointed at through the course of the foregoing observations, and to illustrate which they have been framed, namely, the Use and Pleasure of Scientific Studies.

Man is composed of two parts, body and mind, connected indeed together, but wholly different from

one another. The nature of the union—the part of our outward and visible frame in which it is peculiarly formed—or whether the soul be indeed connected or not with any particular portion of the body, so as to reside there—are points as yet wholly hid from our knowledge, and which are likely to remain for ever concealed. But this we know, as certainly as we can know any truth, that there is such a thing as the *mind*; and that we have at the least as good proof of its existence, independent of the body, as we have of the existence of the body itself. Each has its uses, and each has its peculiar gratifications. The bounty of Providence has given us outward senses to be employed, and has furnished the means of gratifying them in various kind and in ample measure. As long as we only taste those pleasures according to the rules of prudence and of our duty, that is, in moderation for our own sakes and in harmlessness towards our neighbours, we fulfil rather than thwart the purpose of our being. But the same bountiful Providence has endowed us with the higher nature also—with understandings as well as with senses—with faculties that are of a more exalted order, and admit of more refined enjoyments, than any to which the bodily frame can minister; and by pursuing such gratifications rather than those of mere sense, we fulfil the most exalted ends of our creation, and obtain both a present and a future reward. These things are often said, but they are not, therefore, the less true, or the less worthy of deep attention. Let us mark their practical application to the occupations and enjoy-

ments of all branches of society, beginning with those who form the great bulk of every community, the working classes, by what names soever their vocations may be called—professions, arts, trades, handicrafts, or common labour.

1. The first object of every man who has to depend upon his own exertions, must needs be to provide for his daily wants. This is a high and important office ; it deserves his utmost attention ; it includes some of his most sacred duties, both to himself, his kindred, and his country ; and although, in performing this task, he is only influenced by a regard to his own interest or by his necessities, yet it is an employment which renders him truly the best benefactor of the community he belongs to. All other pursuits must give way to this ; the hours which he devotes to learning must be after he has done his work ; his independence, without which he is not fit to be called a man, requires first of all that he should have ensured for himself, and those dependant on him, a comfortable subsistence, before he can have a right to taste any indulgence, either of his senses or of his mind ; and the more he learns—the greater progress he makes in the sciences—the more will he value that independence, and the more will he prize the industry, the habits of regular labour, whereby he is enabled to secure so prime a blessing.

In one view, it is true, the progress which he makes in science may help his ordinary exertions, the main business of every man's life. There is hardly any trade or occupation in which useful les-

sons may not be learned by studying one science or another. The necessity of science to the more liberal professions is self-evident: little less manifest is the use to their members of extending their knowledge beyond the branches of study with which their several pursuits are peculiarly conversant. But the other departments of industry derive hardly less benefit from the same source. To how many kinds of workmen must a knowledge of Mechanical Philosophy be useful! To how many others does Chymistry prove almost necessary! Every one must, with a glance, perceive that to engineers, watch-makers, instrument-makers, bleachers, and dyers, those sciences are most useful, if not necessary. But carpenters and masons are surely likely to do their work better for knowing how to measure, which Practical Mathematics teaches them, and how to estimate the strength of timber, of walls, and of arches, which they learn from Practical Mechanics; and they who work in various metals are certain to be the more skilful in their trades for knowing the nature of those substances, and their relations to both heat and other metals, and to the airs and liquids they come in contact with. Nay, the farm-servant or day-labourer, whether in his master's employ or tending the concerns of his own cottage, must derive great practical benefit, must be both a better servant and a more thrifty, and, therefore, comfortable cottager, for knowing something of the nature of soils and manures, which Chymistry teaches, and something of the habits of animals, and the qualities and growth of plants, which he learns from

Natural History and Chymistry together. In truth, though a man be neither mechanic nor peasant, but only one having a pot to boil, he is sure to learn from science lessons which will enable him to cook his morsel better, save his fuel, and both vary his dish and improve it. The art of good and cheap cookery is intimately connected with the principles of chymical philosophy, and has received much, and will yet receive more, improvement from their application. Nor is it enough to say, that philosophers may discover all that is wanted, and may invent practical methods, which it is sufficient for the working man to learn by rote, without knowing the principles. He never will work so well if he is ignorant of the principles, and for a plain reason : if he only learn his lesson by rote, the least change of circumstances puts him out. Be the method ever so general, cases will always arise in which it must be varied in order to apply ; and if the workman only knows the rule without knowing the reason, he must be at fault the moment he is required to make any new application of it. This, then, is the *first* use of learning the principles of science : it makes men more skilful, expert, and useful in the particular kinds of work by which they are to earn their bread, and by which they are to make it go far and taste well when earned.

2. But another use of such knowledge to handicraftsmen is equally obvious : it gives every man a chance, according to his natural talents, of becoming an improver of the art he works at, and even a discoverer in the sciences connected with it. He is

daily handling the tools and materials with which new experiments are to be made ; and daily witnessing the operations of nature, whether in the motions and pressures of bodies, or in their chymical actions on each other. All opportunities of making experiments must be unimproved, all appearances must pass unobserved, if he has no knowledge of the principles ; but, with this knowledge, he is more likely than another person to strike out something new, which may be useful in art, or curious or interesting in science. Very few great discoveries have been made by chance and by ignorant persons—much fewer than is generally supposed. It is commonly told of the steam-engine, that an idle boy being employed to stop and open a valve, saw that he could save himself the trouble of attending and watching it by fixing a plug upon a part of the machine which came to the place at proper times in consequence of the general movement. This is possible, no doubt, though nothing very certain is known respecting the origin of the story ; but improvements of any value are very seldom, indeed, so easily found out, and hardly another instance can be named of important discoveries so purely accidental. They are generally made by persons of competent knowledge, and who are in search of them. The improvements of the steam-engine by Watt resulted from the most learned investigation of mathematical, mechanical, and chymical truths. Arkwright devoted many years, five at the least, to his invention of spinning jennies, and he was a man perfectly conversant in everything that relates to the construction of machinery : he had

minutely examined it, and knew the effects of each part, though he had not received anything like a scientific education. If he had, we should, in all probability, have been indebted to him for scientific discoveries as well as practical improvements. The most beautiful and useful invention of late times, the Safety-lamp, was the reward of a series of philosophical experiments, made by one thoroughly skilled in every branch of chymical science. The new process of refining sugar, by which more money has been made in a shorter time, and with less risk and trouble than was ever, perhaps, gained from an invention, was discovered by a most accomplished chymist,* and was the fruit of a long course of experiments, in the progress of which, known philosophical principles were constantly applied, and one or two new principles ascertained. But in so far as chance has anything to do with discovery, surely it is worth the while of those who are constantly working in particular employments to obtain the knowledge required, because their chances are greater than other people's of so applying that knowledge as to hit upon new and useful ideas : they are always in the way of perceiving what is wanting or what is amiss in the old methods ; and they have a better chance of making the improvements. In a word, to use a common expression, they are in the way of good luck ; and if they possess the requisite information, they can take advantage of it when it comes to them. This, then, is the *second* great use of learning the sciences : it enables men to make

* Edward Howard, brother of the Duke of Norfolk.

improvements in the arts and discoveries in philosophy, which may directly benefit themselves and mankind.

3. Now these are the *practical* advantages of learning; but the *third* benefit is, when rightly considered, just as practical as the other two—the pleasure derived from mere knowledge without any view to our own bodily enjoyments; and this applies to all classes, the idle as well as the industrious, if, indeed, it be not peculiarly applicable to those who enjoy the inestimable blessing of having time at their command. Every man is by nature endowed with the power of gaining knowledge; and the taste for it, the capacity to be pleased with it, forms equally a part of the natural constitution of his mind. It is his own fault, or the fault of his education, if he derives no gratification from it. There is a satisfaction in knowing what others know—in not being more ignorant than those we live with; there is a satisfaction in knowing what others do not know—in being more informed than they are. But this is quite independent of the pure pleasure of knowledge—of gratifying a curiosity implanted in us by Providence, to lead us towards the better understanding of the universe in which our lot is cast, and the nature wherewithal we are clothed. That every man is capable of being delighted with extending his information upon matters of science, will be evident from a few plain considerations.

Reflect how many parts of the reading, even of persons ignorant of all sciences, refer to matters wholly unconnected with any interest or advantage.

to be derived from the knowledge acquired. Every one is amused with reading a story ; a romance may divert some, and a fairy tale may entertain others ; but no benefit beyond the amusement is derived from this source : the imagination is gratified ; and we willingly spend a good deal of time and a little money in this gratification, rather than in resting after fatigue, or in any other bodily indulgence. So we read a newspaper without any view to the advantage we are to gain from learning the news, but because it interests and amuses us to know what is passing. One object, no doubt, is to become acquainted with matters relating to the welfare of the country ; but we also read the occurrences which do little or not at all regard the public interests, and we take a pleasure in reading them. Accidents, adventures, anecdotes, crimes, and a variety of other things, amuse us, independent of the information respecting public affairs, in which we feel interested as citizens of the state, or as members of a particular body. It is of little importance to inquire how and why these things excite our attention, and wherefore the reading about them is a pleasure ; the fact is certain ; and it proves clearly that there is a positive enjoyment in knowing what we did not know before ; and this pleasure is greatly increased when the information is such as excites our surprise, wonder, or admiration. Most persons who take delight in reading tales of ghosts, which they know to be false, and feel all the while to be silly in the extreme, are merely gratified, or rather occupied, with the strong emotions of horror excited by the momentary belief, for

it can only last an instant. Such reading is a degrading waste of precious time, and has even a bad effect upon the feelings and the judgment.* But true stories of horrid crimes, as murders—and pitiable misfortunes, as shipwrecks—are not much more instructive. It may be better to read these than to sit yawning and idle—much better than to sit drinking or gaming, which, when carried to the least excess, are crimes in themselves, and the fruitful parents of many more. But this is nearly as much as can be said for such vain and unprofitable reading. If it be a pleasure to gratify curiosity, to know what we were ignorant of, to have our feelings of wonder called forth, how pure a delight of this very kind does Natural Science hold out to its students! Recollect some of the extraordinary discoveries of Mechanical Philosophy. How wonderful are the laws that regulate the motions of fluids! Is there anything in all the idle books of tales and horrors more truly astonishing than the fact that a few pounds of water may, by mere pressure, without any machinery, by merely being placed in a particular way, produce an irresistible force? What can be more strange than that an ounce weight should balance hundreds of pounds, by the intervention of a few bars of thin iron? Observe the extraordinary

* *Children's Books* have at all times been made upon the pernicious plan of exciting wonder, generally horror, at whatever risk. The folly and misery occasioned by this error it would be difficult to estimate. The time may come when it will be felt and understood. At present, the inveterate habits of parents and nurses prevent children from benefiting by the excellent lessons of Mrs. Barbauld and Miss Edgeworth.

truths which Optical Science discloses. Can anything surprise us more than to find that the colour of white is a mixture of all others; that red, and blue, and green, and all the rest, merely by being blended in certain proportion, form what we had fancied rather to be no colour at all than all colours together? Chymistry is not behind in its wonders. That the diamond should be made of the same material with coal; that water should be chiefly composed of an inflammable substance; that acids should be, for the most part, formed of different kinds of air; and that one of those acids, whose strength can dissolve almost any of the metals, should consist of the selfsame ingredients with the common air we breathe; that salts should be of a metallic nature, and composed, in great part, of metals, fluid like quicksilver, but lighter than water, and which, without any heating, take fire upon being exposed to the air, and by burning form the substance so abounding in saltpetre and in the ashes of burned wood: these, surely, are things to excite the wonder of any reflecting mind—nay, of any one but little accustomed to reflect. And yet these are trifling when compared to the prodigies which Astronomy opens to our view: the enormous masses of the heavenly bodies—their immense distances—their countless numbers—and their motions, whose swiftness mocks the uttermost efforts of the imagination.

Akin to this pleasure of contemplating new and extraordinary truths, is the gratification of a more learned curiosity, by tracing resemblances and relations between things which, to common apprehen-

sion, seem widely different. Mathematical science, to thinking minds, affords this pleasure in a high degree. It is agreeable to know that the three angles of every triangle, whatever be its size, howsoever its sides may be inclined to each other, are always, of necessity, when taken together, the same in amount : that any regular kind of figure whatever, upon the one side of a right-angled triangle, is equal to the two figures of the same kind upon the two other sides, whatever be the size of the triangle : that the properties of an oval curve are extremely similar to those of a curve, which appears the least like it of any, consisting of two branches of infinite extent, with their backs turned to each other. To trace such unexpected resemblances is, indeed, the object of all philosophy ; and experimental science, in particular, is occupied with such investigations, giving us general views, and enabling us to explain the appearances of nature, that is, to show how one appearance is connected with another. But we are now considering only the gratification derived from learning these things.

It is surely a satisfaction, for instance, to know that the same thing, or motion, or whatever it is, which causes the sensation of heat, causes also fluidity, and expands bodies in all directions ; that electricity, the light which is seen on the back of a cat when slightly rubbed on a frosty evening, is the very same matter with the lightning of the clouds ; that plants breathe like ourselves, but differently by day and by night ; that the air which burns in our lamps enables a balloon to mount, and causes the

globules of the dust of plants to rise, float through the air, and continue their race—in a word, is the immediate cause of vegetation. Nothing can at first view appear less like, or less likely to be caused by the same thing, than the processes of burning and of breathing—the rust of metals and burning—an acid and rust—the influence of a plant on the air it grows in by night, and of an animal on the same air at any time, day, and of a body burning in that air; and yet all these are the same operation. It is an undeniable fact, that the very same thing which makes the fire burn, makes metals rust, forms acids, and enables plants and animals to breathe; that these operations, so unlike to common eyes, when examined by the light of science, are the same—the rusting of metals—the formation of acids—the burning of inflammable bodies—the breathing of animals—and the growth of plants by night. To know this is a positive gratification. Is it not pleasing to find the same substance in various situations extremely unlike each other; to meet with fixed air as the produce of burning, of breathing, and of vegetation; to find that it is the choke-damp of mines, the bad air in the grotto at Naples, the cause of death in neglected brewers' vats, and of the brisk and acid flavour of Seltzer and other mineral springs? Nothing can be less like than the working of a vast steam-engine of the old construction, and the crawling of a fly upon the window. Yet we find that these two operations are performed by the same means, the weight of the atmosphere, and that a sea-horse climbs the ice-hills by no other power. Can

anything be more strange to contemplate ? Is there, in all the fairy-tales that ever were fancied, anything more calculated to arrest the attention, and to occupy and to gratify the mind, than this most unexpected resemblance between things so unlike, to the eyes of ordinary beholders ? What more pleasing occupation than to see uncovered and bared before our eyes the very instrument and the process by which Nature works ? Then we raise our views to the structure of the heavens, and are again gratified with tracing accurate but most unexpected resemblances. Is it not in the highest degree interesting to find, that the power which keeps this earth in its shape and in its path, wheeling upon its axis round the sun, extends over all the other worlds that compose the universe, and gives to each its proper place and motion ; that this same power keeps the moon in her path round our earth, and our earth in its path round the sun, and each planet in its path ; that the same power causes the tides upon our globe, and the peculiar form of the globe itself ; and that, after all, it is the same power which makes a stone fall to the ground ? To learn these things, and to reflect upon them, occupies the faculties, fills the mind, and produces certain as well as pure gratification.

But if the knowledge of the doctrines unfolded by science is pleasing, so is the being able to trace the steps by which those doctrines are investigated, and their truth demonstrated : indeed, you cannot be said, in any sense of the word, to have learned them or to know them, if you have not so studied them as to perceive how they are proved. Without

this you never can expect to remember them long or to understand them accurately ; and that would, of itself, be reason enough for examining closely the grounds they rest on. But there is the highest gratification of all, in being able to see distinctly those grounds, so as to be satisfied that a belief in the doctrines is well founded. Hence, to follow a demonstration of a grand mathematical truth, to perceive how clearly and how inevitably one step succeeds another, and how the whole steps lead to the conclusion—to observe how certainly and unerringly the reasoning goes on from things perfectly self-evident, and by the smallest addition at each step, every one being as easily taken after the one before as the first step of all was, and yet the result being something not only far from self-evident, but so general and strange that you can hardly believe it to be true, and are only convinced of it by going over the whole reasoning—this operation of the understanding, to those who so exercise themselves, always affords the highest delight. The contemplation of experimental inquiries, and the examination of reasoning founded upon the facts which our experiments and observations disclose, is another fruitful source of enjoyment, and no other means can be devised for either imprinting the results upon our memory, or enabling us really to enjoy the whole pleasures of science. They who found the study of some branches dry and tedious at the first, have generally become more and more interested as they went on ; each difficulty overcome gives an additional relish to the pursuit, and makes us feel, as it were, that we have,

by our work and labour, established a right of property in the subject. Let any man pass an evening in vacant idleness, or even in reading some silly tale, and compare the state of his mind when he goes to sleep or gets up next morning with its state some other day, when he has passed a few hours in going through the proofs, by facts and reasoning, of some of the great doctrines in Natural Science—learning truths wholly new to him, and satisfying himself, by careful examination, of the grounds on which known truths rest, so as to be not only acquainted with the doctrines themselves, but able to show why he believes them, and to prove before others that they are true ; he will find as great a difference as can exist in the same being—the difference between looking back upon time unprofitably wasted and time spent in self-improvement : he will feel himself, in the one case, listless and dissatisfied, in the other comfortable and happy ; in the one case, if he do not appear to himself humbled, at least he will not have earned any claim to his own respect ; in the other case, he will enjoy a proud consciousness of having, by his own exertions, become a wiser, and, therefore, a more exalted creature.

To pass our time in the study of the sciences, in learning what others have discovered, and in extending the bounds of human knowledge, has in all ages been reckoned the most dignified and happy of human occupations ; and the name of philosopher, or lover of wisdom, is given to those who lead such a life. But it is by no means necessary that a man should do nothing else than study known truths and

explore new, in order to earn this high title. Some of the greatest philosophers in all ages have been engaged in the pursuits of active life ; and an assiduous devotion of the bulk of our time to the work which our condition requires, is an important duty, and indicates the possession of practical wisdom. This, however, does by no means hinder us from applying the rest of our time, besides what nature requires for meals and rest, to the study of science ; and he who, in whatever station his lot may be cast, works his day's work and improves his mind in the evening, as well as he who, placed above such necessity, prefers the refined and elevating pleasures of knowledge to the low gratification of the senses, richly deserves the name of a true philosopher.

One of the most delightful treats which science affords us, is the knowledge of the extraordinary powers with which the human mind is endowed. No man, until he has studied philosophy, can have a just idea of the great things for which Providence has fitted his understanding—the extraordinary disproportion that there is between his natural strength and the powers of his mind, and the force he derives from them. When we survey the marvellous truths of astronomy, we are first of all lost in the feeling of immense space, and of the comparative insignificance of this globe and its inhabitants. But there soon arises a sense of gratification and of new wonder at perceiving how insignificant a creature has been able to reach such a knowledge of the unbounded system of the universe ; to penetrate, as it were, through all space, and become familiar with

the laws of nature, at distances so enormous as baffle our imagination ; to be able to say, not merely that the Sun has 329,630 times the quantity of matter which our globe has ; Jupiter $308\frac{9}{10}$, and Saturn $93\frac{1}{2}$ times ; but that a pound of lead weighs at the Sun 22 lbs. 15 ozs. 16 dwts. 8 grs. and $\frac{3}{4}$ of a grain ! at Jupiter, 2 lbs. 1 oz. 19 dwts. $1\frac{2}{3}$ gr. ; and at Saturn, 1 lb. 3 ozs. 8 dwts. 20 grs. $\frac{1}{11}$ part of a grain ! And what is far more wonderful, to discover the laws by which the whole of this vast system is held together, and maintained through countless ages in perfect security and order. It is surely no mean reward of our labour to become acquainted with the prodigious genius of those who have almost exalted the nature of man above its destined sphere, when, admitted to a fellowship with these loftier minds, we discover how it comes to pass that, by universal consent, they hold a station apart, rising over all the great teachers of mankind, and spoken of reverently, as if NEWTON and LA PLACE were not the names of mortal men.

The highest of all our gratifications in the contemplations of science remains : we are raised by them to an understanding of the infinite wisdom and goodness which the Creator has displayed in his works. Not a step can we take in any direction without perceiving the most extraordinary traces of design ; and the skill everywhere conspicuous is calculated, in so vast a proportion of instances, to promote the happiness of living creatures, and especially of our own kind, that we can feel no hesitation in concluding that, if we knew the whole scheme

of Providence, every part would be found in harmony with a plan of absolute benevolence. Independently, however, of this most consoling inference, the delight is inexpressible of being able to follow, as it were, with our eyes the marvellous works of the Great Architect of Nature ; to trace the unbounded power and exquisite skill which are exhibited in the most minute as well as the mightiest parts of his system. The pleasure derived from this study is unceasing, and so various that it never tires the appetite. But it is unlike the low gratifications of sense in another respect ; while those hurt the health, debase the understanding, and corrupt the feelings, this elevates and refines our nature, teaching us to look upon all earthly objects as insignificant and below our notice, except the pursuit of knowledge and the cultivation of virtue ; and giving a dignity and importance to the enjoyment of life, which the frivolous and the grovelling cannot even comprehend.

Let us, then, conclude, that the Pleasures of Science go hand in hand with the solid benefits derived from it ; that they tend, unlike other gratifications, not only to make our lives more agreeable, but better ; and that a rational being is bound, by every motive of interest and of duty, to direct his mind towards pursuits which are found to be the sure path of virtue as well as of happiness.

THE
PLEASURES AND ADVANTAGES
OF
LITERATURE AND MORAL SCIENCE.

BY PROFESSOR A. POTTER.

N O T E
ON THE
PLEASURES AND ADVANTAGES
OF
LITERATURE AND MORAL SCIENCE.

THERE are three great subjects which invite the human mind to inquiry and reflection : viz., *God*, *Man*, and *Nature*.

These furnish occasion for three corresponding sciences : viz., *Theology*, or the science of God ; *Anthropology*, or the science of Man ; and *Physics*, or the science of Nature, including within the last all branches which treat of matter, whether organized or unorganized.

The author of the preceding discourse having confined his observations to the pleasures and advantages of Physical Science, it is proposed to add a few remarks respecting the two remaining departments, more especially the second. *Man* forms the subject of inquiry in all treatises of Moral and Political Philosophy, and in most literary works. Hence I have entitled this note *the Pleasures and Advantages of Literature and Moral Science*.

Before entering on this subject, I would make a remark or two in regard to the first of the three

great sciences mentioned above, viz., *Theology*. The Creator has disclosed himself to man in three ways : first, through the *laws* which he has established for the government of mind and matter ; or, in other words, through the *constitution* which he has given to his creatures : secondly, through the course of *human events*, which exhibits not only the operation of fixed laws, but also the presence and agency of a Superintending Mind : and thirdly, in those *supernatural events*, usually called miracles, in which the Deity attests his presence by a temporary suspension of natural laws, and makes known his will through inspired messengers. In studying the laws to which he has subjected all his creatures, we may confine our attention to relations between cause and effect, or we may look beyond these to the *ends* attained, and the proofs thus given of Divine wisdom and goodness. In the one case we study *Philosophy*, in the other *Theology*. This is equally true whether we examine nature or man ; so that he alone has fully studied either of these subjects, whose mind has been led through them to the contemplation of God. That branch of Theology called Natural Theology, forms, in truth, the proper and necessary complement of every system of Physics and Anthropology. Every law of mind and of matter was intended by the Creator as an expression of his nature or will, and must be regarded in this light, not only in order to be comprehended, but also in order to yield that pure and exalted satisfaction which the knowledge of it was designed to afford.

No knowledge is more useful in life, nor is any furnished by human science more fitted to raise the mind to worthy thoughts of the Creator, than *the knowledge of our own nature*. This knowledge we obtain, in part, by consciousness : that is, by observing and reflecting upon the operations of our own minds. But, as we can become acquainted in this way with our own minds only, and can learn nothing of the respects in which other minds may differ from our own, nor determine how far the characteristics observed belong to man *as man*, it becomes necessary to enlarge our acquaintance with our species. Hence the advantage of intercourse with others ; and the more extensive this intercourse is, the better shall we discriminate between what is personal, local, or accidental in human character, and what is permanent, essential, and universal. He who mixes promiscuously with men of various pursuits and parties, or who travels and observes men as they develop themselves in different countries and under different systems of government and religion, must have a much more liberal and enlightened acquaintance with man's nature, than if he had always associated with one class or lived only in one place. Now books serve, in a good degree, as substitutes for travelling and for other methods of studying mankind. They introduce us to men of different stations and employments. They present us with the results of voyages and travels in distant parts of the earth, and among nations and tribes wholly unlike our own. They even take us back to past ages, and enable us to look on

the manners, the arts, the modes of government, and the vicissitudes in power and influence of the most remarkable nations of antiquity. Thus, while setting quietly in our chamber, we are able, if supplied with a few good volumes, to take a more enlarged and thorough survey of our race, than could be gained by a life spent in travelling merely; and though, doubtless, the information thus gained by reading must be coupled with observation and reflection in order to make it just or practically useful, it is, on that account, none the less necessary or valuable.

Biography makes us acquainted with individuals, especially with those who have been eminent for talent or usefulness: *Voyages, Travels, &c.*, introduce us to communities which we cannot survey personally: *History* instructs us in regard to the progress of science and the arts; the condition of men in former times and under various systems of government; the great events which have occupied the thoughts and called forth the energies of other generations; the course of moral and social revolutions; and that varying, but, on the whole, progressive movement, which is gradually carrying forward our race towards a higher civilization. And, besides such works, which propose to exhibit man through his acts, and as he has really been seen at different periods and in different countries, we have other books, in which the wisest and most sagacious minds have set forth their *conclusions* respecting our nature, drawn from a long and intimate survey of it. We have, for instance, *Essays*, like those of Addison,

which dissect, with a most delicate but skilful hand, the workings of the heart, analyzing feeling, exposing folly, rebuking affectation, and correcting vice. We have *Philosophical* works, which discuss matters of higher import, and attempt to unfold the laws that govern the development and operation of all our faculties. We have *Poetry* of every grade, from the lofty Drama or Epic, to the sonnet and stanza, all proposing to "hold the mirror up to nature, to show vice her own feature, scorn her own image, and the very age and body of the time his form and pressure." Each one of these is a source from which he who would sound all the depths and shoals of our nature can derive hints and lessons of inestimable value.

The deep sympathy with which we must always regard our own race, invests moral and literary studies with a peculiar interest. Nor are they deficient in practical utility. We are all charged with the duty of self-improvement; and, to the proper performance of that duty, nothing is more essential than an acquaintance with ourselves—such acquaintance as can be gained only by comparing our personal characters with the original constitution of our nature, and by being fully apprized of the deceitfulness and infirmity of our hearts. We shall be called, too, to operate on the minds of others. As parents, we shall have occasion to guide and influence the minds of our children. As men of business, we shall secure, or fail of success, very much as we can inspire the community with confidence in our judgment and principles, and give direction to the taste

and opinions of those with whom we deal. So, also, in professional pursuits, in our course as citizens, as neighbours, and as men. There are few occasions, indeed, on which we can act wisely and efficiently, without having some regard to the principles of human nature ; and he whose views in this respect are unsettled or narrow, will find in such views a most fruitful source of error and disappointment. Whence is it that some men seem to move with an unerring sagacity towards their object, foreseeing and obviating difficulties, enlisting friends, converting even opposition into aid, and impressing on all a conviction of their power and skill ? It is no superhuman or original instinct with which such men have been endowed. It is rather acquired wisdom and tact, which they have gained by observing closely the characters and actions of men, and the course of human events.

Another advantage of this class of studies is to be found in their effect on mental culture. In order to give full and harmonious development to all our powers, we need studies which address imagination as well as reason—which enlist the feelings while they enlighten the understanding—which call us to balance probabilities, and to analyze complex objects of thought. We need studies which shall accustom us to control the excursions of fancy, and to give them such direction that they shall aid reason, strengthen virtue, and incite to high aspirations after excellence. We need a training that shall enable us to command our thoughts under the most agitating circumstances, and to subordinate our feel-

ings to the authority of judgment and conscience. I need hardly add, that in these respects, no studies can be so useful as those which, by introducing us to our fellow-men at eventful moments, when they are called to act under deep emotion and in view of great interests, train us to the habit of combining judgment with feeling—of consulting truth and right, while we do not stifle sympathy. Mathematical studies cultivate the power of close and continuous attention : physical science gives scope and employment to the practical as well as the speculative reason : but it is the science of man, as unfolded by philosophy, history, poetry, &c., that seems best calculated to make the mind vigilant in observation, jealous of fallacy, vigorous and comprehensive in thought, chastened in taste, and discursive, yet sober, in fancy.

A. P.

A D I S C O U R S E
ON
CLASSICAL, METAPHYSICAL, MORAL,
AND
NATURAL STUDIES.

BY ADAM SEDGWICK, M.A., F.R.S.

[The following extracts, forming a large part of a Discourse delivered a few years since before the Junior Members of Trinity College, Cambridge (Eng.), will be read with interest. They are from the pen of Professor Sedgwick ; and, though written with a special reference to the studies pursued at that University, will be found replete with instruction adapted to the wants of the American people. The remarks will fall under the four following heads : I. *Classical Studies*. II. *Metaphysical Studies*. III. *Moral Studies*. IV. *Relation of Natural and Religious Studies*.]

A DISCOURSE

ON

CLASSICAL, METAPHYSICAL, MORAL, AND NATURAL STUDIES.

IN the first place, let us consider a law and condition of our being, of great influence in the formation of our characters. Impressions independent of the will, whether produced directly through the senses, or by trains of association within the mind, gradually lose their power by repetition ; but habits, whether of mind or body, depending on a previous determination of the will, gain strength by their very exercise, so as at length to become a part of ourselves and an element of our happiness. It is to the operation of this law that we must refer some of the strangest contradictions in human nature. What a melancholy contrast we too often find between the generous temper of youth, and the cold, calculating spirit of a later period ! between the actions of a man at one time of his life and those of another ! I believe there is not one whom I am now addressing, who, if he reflect at all, will not acknowledge how much the cold hand of time has already chilled some of his better feelings. Now it is absolutely certain, that sensuality and other sins to which by nature man is prone, will do their work

in marring the image of God ; and, unless opposed by some countervailing principle, will end in habits making a wreck both of soul and body. In such a state of things a man becomes utterly spellbound ; he is in *the gall of bitterness and the bonds of iniquity*, and has no power to help himself ; and the hand of God alone can help him.

I am not now contending for the doctrine of moral necessity ; but I do affirm that the moral government of God is by general laws, and that it is our bounden duty to study those laws, and, as far as we can, to turn them to our account. As far, at least, as this world is concerned, the feelings on which we act in early life may and do diminish in their intensity ; and yet we may go on in a course, honourable to ourselves and useful to our country, mainly by what is called the force of habit. Of what vast importance is it, then, in youth to lay a good foundation against the coming time, by fostering habits of practical kindness and self-control—by mental discipline and study—by cultivating all those qualities which give elevation to the moral and intellectual character—in one word, by not wavering between right and wrong, but by learning the great lesson of acting strenuously and unhesitatingly on the light of conscience.

A course of academic studies, so far as it relates to mere human learning, divides itself into three branches.

1st. The study of ancient literature, or, in other words, of those authentic records which convey to us an account of the feelings, the sentiments, and

the actions of men prominent in the history of the most famous empires of the ancient world. In these works we seek for examples and maxims of prudence, and models of taste.

2dly. The study of ourselves, considered as individuals and as social beings. Under this head are included ethics and metaphysics, moral and political philosophy, and some other kindred subjects of great complexity, hardly touched on in any academic system, and to be followed out in the more mature labours of after life.

3dly. The study of the laws of nature, comprehending all parts of inductive philosophy.

Our duty in such a system is to secure a good foundation on which to build ; and to this end we must inquire what ought to be the conduct of the mind in entering on any of these great provinces of human learning.

I. CLASSICAL STUDIES.

Before I pass on, I would advert to the wonderful ease with which a child comprehends the conventional signs of thought formed between man and man ; not only learns the meaning of words descriptive of visible things, but understands, by a kind of rational instinct, the meaning of abstract terms, without ever thinking of the faculty by which he comes to separate them from the names of mere objects of sense. The readiness with which a child acquires a language may well be called a rational instinct : for during the time that his knowledge is built up, and that he learns to handle the imple-

ments of thought, he knows no more of what passes within himself, than he does of the structure of the eye or of the properties of light, while he attends to the impressions on his visual sense, and gives to each impression its appropriate name. As the memory becomes stored with words, and the mind accustomed to their application, this readiness of verbal-acquisition gradually decays, and at length, with some persons, almost disappears. That this is true, I need only appeal to the experience of those who, after being long disused to such studies, have attempted to learn a language. They will tell you of their feelings of mental drudgery and intolerable fatigue during their slow, laborious progress, in acquiring what a child gains without knowing how, and a young person learns cheerfully and without a sense of toil. A small part of these remarks applies only to our vernacular tongue and to oral teaching: the greater part bears on the acquisition of all languages—the dead as well as the living. Our fathers, then, have done wisely, and followed nature in making the study of languages a part of our earliest discipline. By this study we gain access to the magazines of thought—we find our way through the vast storehouses wherein are piled the intellectual treasures of a nation, as soon as we have capacity to understand their value, and strength to turn them to good account.

With individuals as with nations, the powers of imagination reach their maturity sooner than the powers of reason; and this is another proof that the severer investigations of science ought to be

preceded by the study of languages, and especially of those great works of imagination which have become a pattern for the literature of every civilized tongue. From time to time there arise upon the earth men who seem formed to become the centre of an intellectual system of their own. They are invested, like the prophet of old, with a heavenly mantle, and speak with the voice of inspiration. Those that appear after them are but attendants in their train—seem born only to revolve about them, warmed by their heat and shining by their reflected glory. Their works derive not their strength from momentary passions or local associations, but speak to feelings common to mankind, and reach the innermost movements of the soul; and hence it is that they have an immortal spirit, which carries them safe through the wreck of empires and the changes of opinion.

Works like these are formed by no rule, but become a model and a rule to other men. Few, however, among us are permitted to show this high excellence. Ordinary minds must be content to learn by rule; and every good system of teaching must have reference to the many, and not to the few. But surely it is our glorious privilege to follow the track of those who have adorned the history of mankind—to feel as they have felt—to think as they have thought—and to draw from the living fountain of their genius. Wonderful and mysterious is the intellectual communion we hold with them! Visions of imagination starting from their souls, as if struck out by creative power, are turned into

words, and fixed in the glowing forms of language : and, after a time, the outward signs of thought pass before our sense ; and, by a law of our being not under our control, kindle within us the very fire which (it may be thousands of years ago) warmed the bosom of the orator or the poet ; so that once again, for a moment, he seems, in word and feeling, to have a living presence within ourselves !

As the body gains strength and grace by the appropriate exercise of all its members, so also the mind is fortified and adorned by calling every faculty into its proper movement. No one will indeed deny, that the imaginative powers are strengthened and the taste improved, especially in young minds, by the habitual study of models of high excellence. It may, however, at first sight well admit of question, when we consider the shortness of life, and the multitude of things demanding our efforts and pressing on our attention, whether a study of the dead languages ought to form a prominent part of academic discipline. Had Europe, after the darker ages, advanced in civilization without the aid of ancient learning, this question might not have been so readily answered in the affirmative. But, without troubling ourselves with imaginary difficulties, we may reply, that the best literature of modern Europe is drawn more or less from the classic source, and cast in the classic mould ; and can neither be felt nor valued as it ought, without ascending to the fountain head—that our superstructure must suffer if we allow its foundations to decay. If this answer be not thought sufficient, there is another which admits

of no reply, and the force of which no time can take away. Classical studies help us to interpret the oracles of God, and enable us to read the book wherein man's moral destinies are written, and the means of eternal life are placed before him.

Assuming, then, that our fathers have done well in making classical studies an early and prominent part of liberal education, there still remains a question whether they are wisely followed up in our academic course. Whatever is taught ought to be taught profoundly : for superficial information is not merely of little value, but is a sure proof of bad training. Hence that critical skill which teaches men to dissect the ancient languages—to unravel all the subtilties of their structure—and to transfuse their whole meaning into a translation, well deserves the honours and rewards long bestowed upon it.

In the department of verbal criticism, some of the mighty men whose names adorn our history have earned a lasting fame ; and have proved how, in their hands, that knowledge which, with vulgar minds, is trifling and without fruit, can be made to assist in the illumination of history, the detection of sophistry, and the support of sacred truth. Few persons are, however, gifted with the powers of a Bentley or a Porson : and, were we permitted to allude to the imperfections of such men, we might perhaps lament that so little even of their time was employed on matter worthy of the giant strength that God had given them.

I think it incontestably true, that, for the last fifty years, our classical studies (with much to demand

our undivided praise) have been too critical and formal; and that we have sometimes been taught, while straining after an accuracy beyond our reach, to value the husk more than the fruit of ancient learning: and if, of late years, our young scholars have sometimes written prose Greek almost with the purity of Xenophon, or composed iambics in the finished diction of the Attic poets, we may well doubt whether time suffices for such perfections—whether the imagination and the taste might not be more wisely cultivated than by a long sacrifice to what, after all, ends but in verbal imitations: in short, whether such acquisitions, however beautiful in themselves, are not gained at the expense of something better. This, at least, is true, that he who forgets that language is but the sign and vehicle of thought, and, while studying the word, knows little of the sentiment—who learns the measure, the garb, and fashion of ancient song, without looking to its living soul, or feeling its inspiration—is not one jot better than a traveller in classic land, who sees its crumbling temples, and numbers, with arithmetical precision, their steps and pillars, but thinks not of their beauty, their design, or the living sculptures on their walls; or who counts the stones in the Appian Way, instead of gazing on the monuments of the “Eternal City.”

There is one province of verbal criticism which has often been overlooked or set at naught, and yet would abundantly repay the labour of its cultivation. Words are the signs of thought; and from words themselves (without following them through all their

inflexions and combinations, in the finished structure of a language), we may see into the natural feelings and judgments of men, before they become warped by the prejudices of sect or the subtilties of system. If, in reading the ancient writers, we meet with words describing virtue and vice, honour and dishonour, guilt and shame, coupled with the strongest epithets of praise or condemnation, then we are certain that these things existed as realities before they became words ; or, at least, that in the minds of those who, during the early progress of society, built up the ancient languages, they were considered as realities ; and on that account (and that account only) had their representatives among the symbols of thought. I believe we might in this way make a near approach to a true system of moral philosophy : and our progress would at every step record a series of judgments, not derived from any doubtful train of reasoning, but forced on men by the very condition of their existence.

We ought to read the classic page, not merely to kindle delightful emotions—to gratify the imagination and the taste—but also to instruct the understanding ; and, to this end, the philosophical and ethical works of the ancients deserve a much larger portion of time than has been hitherto bestowed on them. It is indeed notorious, that during many past years, while verbal criticism has been pursued with so much ardour, the works to which I now allude (coming home, as they do, to the business of life, and pregnant, as they are, with knowledge well fitted to fortify the reasoning powers) have, by the

greatest number, hardly been thought of; and have in no instance been made prominent subjects of academic training. The classical writers did not cultivate the imagination only, but they saw deep into the springs of human thought and action : and, rightly apprehending the capacities of man and their bearing on social life, they laid the foundation of their moral systems in the principles and feelings of our nature, and built thereon a noble superstructure. Should any one object to these ancient systems (as Paley and many other writers have done), and tell us that they are obscure, indefinite, and without sanction, we might reply, that in every question, even of physical science, we take but a few steps towards a first cause before we are arrested by a boundary we cannot pass—before we are encompassed with a darkness no eye can penetrate : that in moral questions (founded, not on the properties of material agents, which we can examine and sift, again and again, by new experiments, but on the qualities of rational and responsible beings), still narrower is the limitation of our inquiries. To suppose that we can reason up to a first cause in moral questions—that we can reach some simple principle, whence we may descend with logical precision to all the complicated duties of a social being, is to misapprehend the nature of our faculties, and utterly to mistake the relation we bear both to God and man. Such a system may delight us by its clearness, and flatter our pride because it appears at once to bring all our duties within our narrow grasp : but it is clear only because it is shallow ; while a better system

may seem darker only because it is more profound.

If it be contended that, in the trying circumstances of life, the moral systems of the ancients are without motives, we may reply, that in this respect all moral systems are alike—that all of them lead to consequences and point to actions beyond the power of any earthly sanction. When we ascend to the highest virtues and capacities of our moral nature, and think of the tens of thousands who in every age have encountered a voluntary death for the good of their kindred men and the glory of their country, or the still more exalted heroes who have died as solitary martyrs in the defence of some high and holy principle, we tell of deeds which moralists and historians of every age have adorned with their praise and held up for imitation. But still, however common acts like these may have been in the history of mankind, we have no right to class them as social duties, grounded in mere moral and social feelings ; and, in accounting for them, our souls recoil from the vulgar sanction of this world's praise. If deeds like these be compatible with our nature, then is there something within us which, however obscured or ill-formed, points to a higher destiny : and, in asking for motives, we must quit the province of morals and enter on that of religion ; and in its hopes, faint and feeble as they may often be, we may not only find an answer to our question, but a reason why such high feelings and capacities are implanted in us ; leading us, as they do, into acts

opposed to the strongest instincts of our nature, and above the sanction of all ordinary moral rules.

It is, I think, certain, that the study of an ethical system, grounded on the moral and social feelings, and exemplified by that course of action which in all ages has been honoured by the virtuous and the wise, is not only a good practical training of the mind (which, in the busy commerce of life, has often more to do with moral than with physical reasoning), but prepares it for the acceptance of religious truth. Whether this opinion be true or false, it is at least certain, that many of the writers of antiquity had correct notions on the subject of natural religion. The argument for the being of a God, derived from final causes, is as well stated in the conversations of Socrates as in the *Natural Theology* of Paley. Nor does Socrates merely regard God as a powerful first cause, but as a provident and benevolent being: and he tells us, that as man is the only animal with a soul capable of apprehending God, he is the only being by whom God is worshipped—that prayer and sacrifice are our duty—that by such services we may learn some of the secrets concealed from men, and know that the Divinity sees everything, hears everything, is present everywhere, and cares for all his works.

[But were it true (which it certainly is not) that the heathen writers never argued from final causes to the being of a God, still we should not be justified in saying that the argument had no weight when handled by a Christian. Truths, whether physical or moral, are not less real because they have been

hidden for many ages, and are only brought to light by the progress of other truths. No wonder that the truths of natural religion should have been oftener pressed by Christian than by heathen writers. The Christian makes them not the foundation of his faith. He seeks them not because he doubts, but because he believes : for they are the external means of communion with a being whom he is taught to love, and in whose more immediate presence he hopes hereafter to dwell. It is through these embodied truths that in the mechanism of his own material frame—in the wonderful adaptation of his senses to the material world without—in the constitution of his mind, whereby he learns the existence of intellectual natures like his own—in his power of modifying the order of events by the operation of his will—in his capacity of ascending from phenomena to laws, and of contemplating through them the marks of preordaining wisdom—it is through these truths that, in all the world around him, in whatsoever manner his soul regards it, he is taught to read an ever-living lesson of the benevolence and the power of God.

We think that we have some adequate knowledge of our fellow-beings, because they resemble what we have a consciousness of within ourselves. Without stopping to inquire how we come by this knowledge, let us suppose some one to ask how we come by the knowledge of a God : we can only reply, as has often been done before, that we know him by his works, animate and inanimate, and by the written revelations he has given of himself. Should, how-

ever, this interrogator go on to say, that God speaks not to us through his works, but only through the words of his revelation, wherein he told us from the beginning that *He created the heaven and the earth*, we may then retort another question, and ask, what knowledge could mere sounds like these convey through the ears to the heart, were there not already placed within it some knowledge of the being of a God ; or, at least, were there not in the soul some natural and inborn power of rising to the apprehension of a general religious truth, when presented to it in the form of a mere abstraction ?

That our knowledge of God is in a certain sense inadequate, whether it be conveyed to us as a truth of natural or revealed religion, no one can for a moment doubt. It may be suited to our wants, but it can bear no measure to his glory. *No man hath seen God at any time*, because he is everywhere. And if he has sometimes, during the brief history of man, given a sensible manifestation of his more immediate presence, it has been by stripping himself (if I may so speak) of his attribute of ubiquity, and condescending to put on the semblance of some material power, or the glorified similitude of the human form. So also, in the language of his written word, he is either described by negatives, or divested of his immaterial attributes, that he may be brought down to the grasp of human thought. Not only in the extent and power of his operations, but assuredly also in their very kind, he is infinitely above the reach of man's imagination. If revelation cannot, without a miracle, give to a blind man any knowl-

edge of the sensations caused by the pulsation of light upon the eye, still less can it convey to the mind's eye any knowledge of God that is not limited by the conditions of our being. Surely we may, then, believe, that in religious knowledge there is much that is imperfectly comprehended: and if, in the natural world, each step of discovery bring to light new and unexpected truths, we may well believe that a revelation, expounding our moral condition in relation to God, and giving us a glimpse of our future destinies, must also bring to light something that is above reason—something that is new and unlooked for.

Let me not, however, be misunderstood. If revelation teach knowledge above reason, it does not thereby destroy the fair inductions of reason, otherwise the God of nature would be in contradiction with himself. A demonstration is not the less true because it is confined to its own premises: and, if we deny the value of natural truth because of the narrowness of our faculties, we might, by like reasoning, set religious knowledge at naught, because it is limited by the conditions of our intellectual nature. In one word, whether we argue from man's ignorance or knowledge, we have no right to rob him of his inborn capacities—of the power of ascending from phenomena to the contemplation of laws, and of deducing general truths—of discerning the marks of designing wisdom in the universe—and of seeing that there is, over all matter and all mind, the will of a presiding God.

In confirmation of the views here advanced, I

would refer to Xenophon's *Memorabilia*, Book i., Chap. iv. The following passage shows Socrates' strong and graphic manner of putting the argument from final causes.

"But since there are many things, some of which we can easily see the use of, while we cannot say of others to what purpose they were produced; which of these, Aristodemus, do you suppose the work of wisdom?

"It should seem the most reasonable to affirm it of those whose fitness and utility are so evidently apparent.

"But it is evidently apparent, that He who at the beginning made man, endued him with senses because they were good for him; eyes wherewith to behold whatever was visible; and ears to hear whatever was to be heard. For say, Aristodemus, to what purpose should odours be prepared, if the sense of smelling had been denied? Or why the distinctions of bitter and sweet, of savoury and unsavoury, unless a palate had likewise been given, conveniently placed, to arbitrate between them, and declare the difference? Is not that Providence, Aristodemus, in a most eminent manner conspicuous, which, because the eye of a man is so delicate in its contexture, hath therefore prepared eyelids, like doors, whereby to secure it; which extend of themselves whenever it is needful, and again close when sleep approaches? Are not these eyelids provided, as it were, with a fence on the edge of them, to keep off the wind and guard the eye? Even the eyebrow itself is not without its office, but,

as a penthouse, is prepared to turn off the sweat, which, falling from the forehead, might enter and annoy that no less tender than astonishing part of us. Is it not to be admired, that the ears should take in sounds of every sort, and yet are not too much filled by them? That the fore teeth of the animal should be formed in such a manner as is evidently best suited for the cutting of its food, as those on the side for grinding it in pieces? That the mouth, through which this food is conveyed, should be placed so near the nose and the eyes as to prevent the passing, unnoticed, whatever is unfit for nourishment; while nature, on the contrary, hath set at a distance, and concealed from the senses, all that might disgust or any way offend them? And canst thou still doubt, Aristodemus, whether a disposition of parts like this should be the work of chance, or of wisdom and contrivance?"—*S. Fielding's Trans.*

I quote this passage in the hopes of inducing the reader to reconsider the whole chapter; both for its own value, and because it is in itself an ample refutation of an opinion unaccountably maintained by some writers, that the heathen philosophers of antiquity had no knowledge of God, except what was derived through a corrupted tradition.]

Few, however, of the heathen philosophers conceived or uttered sentiments like these; and, trained as they were in a superstition which deified their bad passions and sanctioned their vices under the impure forms of its religious rites, we need not wonder at their limited knowledge of the attributes of

God, or their feeble hopes of a more exalted state of future being.

In speaking of the spirit which ought to guide us in our classical studies, we must look also to their lessons of practical wisdom. History is to our knowledge of man in his social capacity, what physical experiments are to our knowledge of the laws of nature : and well it is for that country which learns wisdom by the experiments of other nations. In ancient history we can not only trace the fortunes of mankind under almost every condition of political and social life, but all the successive actions we contemplate are at such a distance from us, that we can see their true bearings on each other undistorted by that mist of prejudice with which every modern political question is surrounded. We may see that the higher virtues, which are the only secure foundation of a nation's strength, are confined to no time or country ; and although sometimes called into their fullest action by a sudden and trying circumstance, are, in the common course of things, but the slowly matured fruit of good discipline and good government. We may look on states rising out of small beginnings, and watch the means by which they gradually ascend in the scale of national strength. We may mark the giant power of despotism wasting away before a petty combination of free men. We may see that liberty is the handmaid of genius and virtue—that, under her fostering care, feelings and sentiments, imbodied in national literature, spring up and knit men together as one family, and, for a time, give them an almost unconquerable

might ; and, lastly, that the loss of national sentiments and national independence, whether commencing in decay from within or violence from without, is alike followed by moral and physical desolation.

We study to little purpose, if, while we unroll the history of past time, we look but at one side of the portraiture of our race. If we read in it the maxims of wisdom, we find also the annals of crime. If great actions have shown man's high capacities, the sins and follies by which all history is blotted prove also the feebleness of his purpose. We may find in every page the records of selfishness—the desolation produced by the jarring interests of faction. We may see that the foulest crimes have oftentimes been enacted under the fairest forms of government ; and that, in all conditions of a state (from its beginning to its end), corruption of manners is ever incompatible with true liberty. We may trace the history of a vast empire from its first beginnings—find it, after many mutations of fortune, rising to great power by the exercise of great virtue—and, during the lapse of ages, see its citizens jealous, even to a crime, of their civil freedom. We may then go on, and find the same people becoming willing tools in the hands of bad men, and, at length, so utterly corrupt as to rush, with one consent, into the basest servitude ; and, in those evil days, we may find that even the best men were willing to surrender their inheritance, and to seek in the despotic authority of one a refuge against the more intolerable license of the many. We leave, however, our les-

son incomplete if we follow not this history to its end; and see that the calm of despotism, superinduced on a corruption of manners, is followed by a stagnation of all the higher virtues which minister to national strength; and so becomes but the dismal presage of dismemberment and final dissolution.

In the moral as in the physical convulsions of the world, the good and the bad are often mingled together in a common calamity; and, were we to limit our views to this life only, we might see, in the dealings of God with man, much to perplex and to confound us. Still it is true, even in this narrow view, that there is in the history of past times enough to show that God will, in the end, vindicate his character as a moral governor: for we find that, in all ages, virtue and wisdom have been the only firm supports of national strength—and that, as in individual men, where sin rules in the bodily members, there is a degrading moral servitude, and a loss of capacity for high thought and action—so, also, that among states and empires, depravity of manners has ever been followed by a loss of glory and a loss of freedom. Hence we may conclude, on a large experience, grounded on all history, past or present, sacred or profane, that those public men who have sought to gain their ends by inflaming the bad passions of the people and pandering to their vices, have been traitors to the cause of true liberty, and blasphemers against the very God they professed to worship.

Another conclusion, not less general than the former, may also be drawn from the universal experience of past history—that under no form of govern-

ment is man to be maintained in a condition of personal happiness and social dignity without the sanction of religion. Finally, as all material laws, and all material organs throughout animated nature, are wisely fitted together, so that nothing of which we comprehend the use is created in vain; and as the moral and intellectual powers of man, working together according to the laws of his being, make him what he is—teach him to comprehend the past, and almost to realize the future, and rule over his social destiny; we may surely conclude, as a fair induction of natural reason, that this religious nature (so essential to his social happiness) was not given him only to deceive him; but was wisely implanted in him, to guide him in the way of truth, and to direct his soul to the highest objects of his creation.

II. METAPHYSICAL STUDIES.

I now enter on the second branch of our studies, in which we are ourselves considered philosophically as individuals and as social beings. Under this head are included many subjects of great complexity, requiring for their investigation long habits of patient thought—bearing directly on the business of life—and in their application deeply affecting our moral and intellectual characters. If the shortness of time permits us not, in an academic course, to enter largely on this great province of inquiry, and if some departments of it are fitted only for the labours of after life, we are at least bound to give, as far as we are able, a right bias to youthful sentiments on all great questions concerning human na-

ture, so that, in entering on our moral studies, we may be enabled to lay a good foundation, whereon, in maturer manhood, to build in safety.

Locke's "Essay on the Human Understanding," and Paley's "Principles of Moral and Political Philosophy," have long formed such prominent subjects of study, that the remarks I shall make under this head will be almost confined to these two works.

It is, perhaps, unnecessary for me to state, that Locke supposed the mind to be first of all "as white paper, void of all characters," and that all its subsequent ideas—all its materials of reason and knowledge, are derived from two sources, sensation and reflection. By ideas from sensation, he means the natural perceptions we have of external things through our senses; by reflection, he understands the notice the mind takes of what passes within itself, "whereby it becomes furnished with ideas of its own operations:" and he affirms, "that, however great the mass of knowledge lodged within the mind, there can be nothing there which did not come in by one of these two ways."

It is incontestably true, that the senses are the first avenues of our knowledge, and that, through them, we become first acquainted with external things. In describing the modes in which the mind is furnished with knowledge through the senses, the "Essay on the Human Understanding" is, I think, rather to be considered as defective in execution than faulty in principle. Since its publication, much good service has been done in this department of inquiry by Reid and other writers; but much, if I

mistake not, still remains to be done ; and, were I to speculate on the coming fortunes of philosophical literature, I should look forward to the time when some one, learned in physiology, instructed in all the laws of those elastic fluids by which they are surrounded and acted on, and skilled in the analysis of the inner workings of the mind, shall bring his strength to bear on this one subject, and present us with a work detailing the whole office of the senses, from childhood to manhood—from the dawn of reason to its full maturity.

In discriminating the ideas we derive from reflection, and pointing out the modes in which the mind is gradually raised to its full strength and stature, the “*Essay on the Human Understanding*” is not only defective in execution (sharing the common fortune of man’s work), but is also, I think, faulty in its principles. The account it gives of some of our simplest abstract notions is erroneous ; parts of the work are doubtful and obscure ; and the whole greatly devoid of philosophic symmetry and order.* Still there are in every chapter of it the marks of deep thought ; of a strong mind clearing away the masses of intellectual rubbish by which his whole subject

* It is impossible, in a sketch like this, to descend into particulars ; but, without alluding to the faults of omission, I may, in justification of what is here stated, point out, by-the-way, that Locke’s account of the origin of our idea of *time* is universally considered as wrong ; that, by a large school of metaphysicians, his account of our knowledge of space is regarded as not less erroneous ; that most men look upon his discussions respecting personal identity and the determination of the will as either defective or false ; and that there is no one who does not regard his dissertation on *power* as crude and obscure.

was encumbered ; and, above all, of a lofty, independent spirit, holding allegiance to no authority but that of truth. Hence, whatever the coming history of letters may bring to light, I cannot imagine the day when the works of Locke, under proper limitations, will not form noble subjects for academic study.

Men seem to differ little in the impressions they first receive from their senses ; and perhaps quite as little in the first abstractions they are by nature led to form. Yet how widely separated is one intellect from another ! From the stones of the same quarry one man builds a hovel ; another chisels out the breathing image of the human form. It is incontestably true, that men are distinguished from each other by their habits of combining the same original elements of thought. But, in making these combinations, they are not led on blindly and fortuitously, but in obedience to intellectual laws, operating with greater or less force on every rational being. What would be the value of the senses were there no sentient principle within ? And where would be the use of teaching, were there no inborn capacities in the soul to apprehend and to be acted on ? It may be true that we have no innate knowledge ; but we have innate intellectual powers : and that they are the same in all men, differing only in degree, is evident from the individual habits, the social sympathies, the civil institutions, and the languages of our race—the common feelings that hurry us into action—the common proofs that gain our deliberate assent.

The distinction between innate ideas and innate

capacities is almost overlooked in the work of Locke.* To this cause we must attribute the greatest mistakes and imperfections of his system, and the strange omission of many of the highest faculties of our nature. Of the imaginative powers he hardly says one word, or speaks of them only to condemn them. Yet are they so woven into our nature that they mingle themselves with almost every word and deed—aid us in the interchange of thought—ever give delight in their exercise, both to savage and civilized man—nor can they for a moment be put off except by an effort of the mind, in the severe abstractions of exact science. For a metaphysician to discard these powers from his system, is to shut his eyes to the loftiest qualities of the soul; and is as unaccountable as it would be for a physiologist to overlook the very integuments of our animal frame.

It is by the imagination, more perhaps than by any other faculty of the soul, that man is raised

* The habit of disregarding the distinction between abstract capacities and their particular manifestations, seems to have led Locke into his strange paradox respecting personal identity. Consciousness (in the sense in which he uses the word) is the proof of our own identity to ourselves; and it is through this principle in our nature that we know that we continue one and the same being, and feel that we are personally responsible for our past actions. Remembering or associating the past with the present is one of the faculties of a rational being. But the individual mind existed anterior to the manifestation of this faculty; otherwise there is no common connecting principle among our thoughts, and no such thing as personal identity. In the chapter on "our ideas of substances," he considers a "spiritual substance as the *substratum* of those simple ideas we have from without;" and he justly discriminates between the soul itself and the manifestation of its powers. His distinction is well drawn; but it is, I think, at variance with his discussion on personal identity.

above the condition of the beast. Beasts have senses in common with ourselves, and often in higher perfection : to a certain extent also they possess, I think, the powers of abstraction, though this is denied by Locke ; but of the imaginative powers, they offer, perhaps, no single trace. These high attributes of the soul confer on it a creative energy—aid it even in its generalizations from pure reason—bring before it vivid images of the past, and glowing anticipations of the future—teach it to link together material and immaterial things, and to mount up from earth to heaven. All that is refined in civilized life, all that is lofty in poetry or ennobling in art, flows chiefly from this one fountain.

As a matter of fact, men do possess imaginative powers, and ever have delighted, and ever will delight, in their exercise : and to exclude them from a system of psychology is to mutilate, and not to analyze, the faculties of the soul. They may have been abused ; but what of that ? every faculty has been abused and turned to evil. Shall we, then, not merely overlook the powers of imagination, but, with Locke, regard men who appeal to them in their proofs and mingle them in their exhortations as no better than downright cheats ? If this be our conclusion, then must the sublime morality of Job—the inspired song of David—the rapturous anticipations of deliverance in the prophecies of Isaiah, stamped in the loftiest forms of poetic imagery, and falling on the ear as if proclaimed by an angel's voice from the gates of heaven—and the fervent testimony of thousands of holy men in every age,

declaring and enforcing the oracles of God—all and every one of these heart-stirring appeals must fall under our cold and senseless condemnation.

In denouncing the exercise of the imagination as a fraud upon the reason, Locke would have done well had he been considering mere demonstrative truth ; but I find no such limitation to his censures. All reason is not mathematical, nor is all truth demonstrative : and one fault of the *Essay* of Locke is its attempt to extend too far the boundaries of demonstration. It would, indeed, be as absurd to apply imaginative language to the demonstration of pure reason, as to apply the language of demonstration to the analysis of ideal beauty. Each faculty must have its proper place ; but none can be so lopped off without marring the handiwork of God.

If it be demanded what is the office of the imagination, we may reply, that its office consists in its appropriate exercise conjointly with every other faculty of the soul. In one respect, however, its use, as well as its abuse, is so obvious as to deserve a formal notice. Men decide not on reason only—incline not naturally to the right side, like the scale of a balance, by the mere weight of evidence. They act in common cases through habit or affection ; and, in trying circumstances, the determination of the will is often more by feeling than by reason. Hence the imaginative powers, in kindling up the active feelings of the soul, have ever been mighty instruments of persuasion, whether for good or for evil. When Demosthenes, in pleading before the Athenian multitude, swore by the souls of

his fellow-countrymen who had perilled their lives in battle on the field of Marathon—and when St. Paul, speaking in the presence of King Agrippa, held up his hand before the assembled crowd, and wished to God that every one of them was not only almost, but altogether as himself, excepting his bonds—each spoke from the momentary fulness of his own feeling—each spoke to the hearts and bosoms of those around him, and put forth a weapon of persuasion a thousand times more sharp than ever issued from the cold armory of reason.

Another great fault in the Essay of Locke (involved, I think, in his very system, which, looking only to the functions of the soul, forgets its innate capacities) is its omission of the faculties of moral judgment. That such faculties exist, is proved by the sense of shame in a child, by the natural feelings of manhood, by the language of every country, and the code of every nation; and, lastly, by the word of God, which speaks of conscience not as a word of convention—a mere creation of the social system, but as something implanted in our bosoms by the hand of our Maker, to preside there and pass judgment on our actions. We read of men *convicted in their own conscience—living in all good conscience—we are told of the law written in the hearts (of the Gentiles), and of their conscience also bearing witness—we read of a conscience void of offence—of the answer of a good conscience towards God—of holding faith and a good conscience—and of a conscience seared with a hot iron through long familiarity with sin.* What meaning have words

like these, if we may at our own will strip conscience of its sanction, and think of it no longer as a heaven-born rule of action?

The faculties of moral judgment, combined, to a certain degree, with power of choice and liberty of action, not only distinguish us from the lower beings of creation, but constitute the very essence of our responsibility both to God and man. Their omission, then, is a great blemish in any system of psychology.

Let it not be said that our moral sentiments are superinduced by seeing and tracing the consequences of crime. The assertion is not true. The early sense of shame comes before such trains of thought, and is not, therefore, caused by them ; and millions, in all ages of the world, have grown up as social beings and moral agents, amenable to the laws of God and man, who never traced or thought of tracing the consequences of their actions, nor ever referred them to any standard of utility. Nor let it be said that the moral sense comes of mere teaching—that right and wrong pass as mere words, first from the lips of the mother, and then from man to man ; and that we grow up with moral judgments gradually ingrafted in us from without, by the long-heard lessons of praise and blame, by the experience of fitness, or the sanction of the law. I repeat, that the statement is not true—that our moral perceptions show themselves not in any such order as this. The question is one of feeling ; and the moral feelings are often strongest in very early life, before moral rules or legal sanctions have once been

thought of. Again : what are we to understand by teaching ? Teaching implies capacity : one can be of no use without the other. A faculty of the soul may be called forth, brought to light, and matured, but cannot be created, any more than we can create a new particle of matter, or invent a new law of nature.

Philosophy is not grounded on external authority, but in the observed nature of the things we contemplate, whether they be material or immaterial. We may invent systems of legal ethics, drawn from the prudential maxims of society, or we may act on a system of Christian ethics, founded on the positive declarations of the word of God : but without an inherent moral capacity, without a moral sense placed in the breast of man, by the same hand that made him, the science of moral philosophy has not, I think, the shadow of any foundation whereon to rest.

Returning, then, to the point from which we started : if the mind be without innate knowledge, is it also to be considered as without innate feelings and capacities—a piece of blank paper, the mere passive recipient of impressions from without ? The whole history of man shows this hypothesis to be an outrage on his moral nature. Naked he comes from his mother's womb, endowed with limbs and senses indeed, well fitted to the material world, yet powerless from want of use : and, as for knowledge, his soul is one unvaried blank ; yet has this blank been already touched by a celestial hand, and, when plunged in the colours which surround it, it takes not its

tinge from accident, but design, and comes forth covered with a glorious pattern.

If the senses be the first link connecting the soul with the world without, it is equally certain that they are no sooner excited than the affections begin to show themselves : not long after, the moral and imaginative powers appear to germinate, feebly and interruptedly it may be, yet with vigour enough to show that they were rooted in the soul by the same hand that formed it. The powers of pure reason come later into exercise, and at length, by the joint action of all his powers, man becomes what he is—a social, a moral, and an intellectual being—fitted in all his capacities for the material world without, and for the social condition in which God has placed him. Some of his faculties may be powerless because untried—may have withered for want of nourishment ; others, by good training, may have reached their full maturity : but no training (however greatly it may change an individual mind) can create a new faculty, any more than it can give a new organ of sense. In every branch of philosophy the limitations are alike ; we may observe the phenomena and ascend to laws, and, by another movement of the mind, ascend to the notion of intelligent causation : but, in coming down from these laws to their practical application, creative power is ever out of the question with us, whether we have to do with the material or immaterial world ; and every change produced by philosophic skill is still subordinate to all the phenomena from which we first ascended.

To the supposition of an innate capacity of moral judgment, some one may oppose the passions, the vices, and the crimes of mankind; and thence infer either that man is without moral capacity, or that conscience is utterly devoid of sanction. We may, however, reply, that, under the blind impulse of passion, men not only take that side which their conscience warns them to be wrong, but also, in a thousand cases, wilfully do that which reason tells them to be against their highest interest: and if, after all this, we do not deny the faculty of reason, neither ought we to deny the reality of a moral sense. In a diseased action of the bodily frame, the organs of life may become the implements of death: but no one, on that account, discards the inductions of physiology—denies that all parts of the frame are skilfully knit together—or ceases to believe that every organ has its fitting use. So, in the immaterial part of man, sin, like a burning fever, may make havoc among his highest faculties, and end in moral death: but we have no right on that account to regard sin as our proper condition, or to affirm that it is not a moral pestilence destructive of the supreme law of our moral nature. Neither have we any right to say that it blots out the knowledge of good and evil, and overturns the judicial throne of conscience. Such a decision is at war with the recorded judgments of mankind, and strikes at the foundation of all human law. Sin may hold our souls in bondage: but, as long as reason lasts, it destroys not our responsibility; nor is the con-

tinued perpetration of crime ever tolerated as a plea in bar of a penal sentence.

The objection just considered does, however, prove the feebleness of moral rule—shows that there is something wrong within us, which jars with nature's harmony—that there is in the moral government of God much that is beyond the grasp of mere philosophy; and so teaches us to look beyond this world, and in the consolations of religion, and the hopes of a future life, to seek a better and a higher sanction; and in the motives of Christian love, to find a steadier and more abiding principle of holy action, than all the philosophy upon earth ever has given, or ever can give to man in the hour of temptation.*

With all its faults, the “Essay on the Human Understanding” is a work of great power; and, were any one to need a proof of this, he has only to consider the impression it produced on the speculations of a former age. Its greatest fault is the contracted view it takes of the capacities of man: allowing him, indeed, the faculty of reflecting, and following out trains of thought according to the rules of abstract reasoning, but depriving him both of his powers of imagination and of his moral sense. Hence it produced, I think, a chilling effect on the philosophic writings of the last century; and many a cold and beggarly system of psychology was sent

* On the subject here alluded to, I would earnestly recommend to the reader's perusal an excellent sermon by Dr. Chalmers, entitled “The Expulsive Power of a new Affection.”

into the world by authors of the school of Locke; pretending, at least, to start from his principles and to build on his foundation. It is to the entire domination his "Essay" had once established, that we may, perhaps, attribute all that is faulty in the Moral Philosophy of Paley—the work on which I now proceed to comment.

III. MORAL STUDIES.

I would ever wish to speak with reverence of a man who did, I believe, during his time, much more for the cause of revealed truth than any other writer of his country. His homely strength and clearness of style, and his unrivalled skill in stating and following out his argument, must ever make his writings popular: and, speaking for myself, I cannot describe, in terms too strong, the delight I once experienced in studying his Moral Philosophy, where truth after truth seemed to flash on the mind with all the force of demonstration—on questions, too, which in other hands seemed only involved in mystery and doubt. On this account, if there be a defective principle in his system, it ought the more boldly to be combated, lest the influence of his name and the charm of his philosophic manner lead us only the farther from the truth.

He commences by denying the sanction and authority of the moral sense; and brings the matter to a point by putting forth an instance, which, like an *experimentum crucis*, is at once to be decisive of the question. Having detailed a case of cold-blooded parricide, he asks whether "a savage, cut off in his

infancy from all intercourse with his species, would, when told of this, feel any sentiment of disapprobation." We may reply (as Paley seems to do), that he certainly would not : for neither could he possibly comprehend the meaning of the tale, nor, if he did, could he find a word to express his natural abhorrence of the crime. If this reply be thought too technical, and only a shifting of the difficulty, we may meet the case in a different way, and combat one ideal instance by another. Suppose a solitary being placed from childhood in the recesses of a dungeon, and shut out from the light of day, then must he grow up without one idea from the sense of sight. But should we thence conclude that the sense was wanting? Let him be brought into the light ; and by the laws of vision, over which he has no control, he will, like other beings, gain knowledge from the sense of sight. Let the solitary savage, in like manner, come from the recesses of the forest into commerce with his fellow-beings ; and he will also, by the law of his intellectual nature, as inevitably gain a sense of right and wrong ; and he will then pass a natural judgment on the crime of parricide, like that of any other rational and responsible man. No one now speaks of an innate knowledge of morality : an innate moral sense or faculty, defining and determining the quality of our moral judgments, is all for which we contend ; and Paley's instance is quite worthless for his argument.

Had he grounded his rejection of the moral sense on the avowed depravity of our nature, and the impotency of moral rule in putting down the

evil that is at war with our better feelings, we should, with one mind, have allowed the force of his objection ; and some would, I doubt not, have accepted his conclusion. In so doing they would, however, have done wrong : for the rejection of the moral sense on religious grounds is one of the errors of fanaticism. Amid all the ruin that is within us, there are still the elements of what is good ; and were there left in the natural heart no kindly affections and moral sentiments, man would be no longer responsible for his sins ; and every instance of persuasion against the impulse of bad passion, and of conversion from evil unto good, would be nothing less than a moral miracle. On such a view of human nature, the apostles of our religion might as well have wasted their breath on the stones of the wilderness as on the hearts of their fellow-men in the cities of the heathen.

Had Paley, rejecting the authority of the moral sense on grounds like these, proceeded to build up a system of Christian ethics, founded on the word of God, enforced by its heavenly sanction, and recommended through the affections to a practical acceptance as a rule of life, he might have conferred a great benefit on the cause of morality and religion. He might then have gone on to show, that the code of Christian morals contains a set of rules co-ordinate with other rules, which the wise and the good of all ages have endeavoured to establish and enforce (with a fainter light, indeed, and under a more feeble sanction), as in accordance with the law of our nature, and, therefore, with the will of

God : and afterward he might have proved, that the rules of action, derived from these two sources, are not only in conformity with each other, but call our highest faculties into activity, and return into our bosoms incomparably the greatest sum of earthly happiness. Thus might he have arrived at a perception of an attribute of God, in the only way in which it is permitted us, by the mere force of natural reason, to reach high points of knowledge—by ascending from particular to general truths, from phenomena to laws ; and thus might he have concluded, that as in the material world we see in all things the proofs of intelligence and power, so, also, that in the immaterial world we find proofs, not less strong, that man is under the moral government of an all-powerful, benevolent, and holy God. Following this train of thought, he might, lastly, have enunciated a proposition (resembling in its words what stands in the front of his moral system, but far different in its meaning and incomparably more true), that whatever is right is also expedient for man.

Whatever be the faults of Paley's system, assuredly they spring not from fanaticism. After rejecting the moral sense, but on no such grounds as have been just imagined, he proceeds to prove (by reasoning I shall shortly examine), that actions are only to be estimated by their general tendency—that utility is the touchstone of right and wrong. Here we have a rule, simple in its enunciation, and flattering to human pride : for man no longer appears as the subject of a law, but presides with the

authority of a judge, and his rule of action is the leading interest of himself and his fellow-men.

In the material world we have no control over the laws of nature ; we gain physical knowledge only by studying them, and new physical power only by obeying them : and in questions of morality—of right and wrong—we are equally the servants of a law, either written in the heart, or recorded in the word of God. To hesitate is to rebel ; and to wait for the calculations of utility would be, too often, but to seek a cloak of sophistry as a shelter for evasion.

Leaving, however, mere general objections, let us come to the system itself, and to the rule of its application. Paley first resolves all right into consistency with the will of God : and here, at least, is no matter for dispute ; for every moral system implies some law or other, which can only emanate from God, and to obey that law is plainly to obey his will. But how are we to discover that will ? We answer, by studying the moral nature of man, and his relation to things around him ; by ascending from moral phenomena to moral laws, which thus become the manifestations of the will of God, and may be embodied in the maxims of moral philosophy : or, by humbly accepting the revelation of his will, which is religious knowledge. But, by whatever means we try to discern the will of God—by whatever path we endeavour to ascend towards his holy temple—we see but in part, and understand but in part ; we grasp not one of his attributes ; we comprehend not how they coexist within his bosom ; we remain but worshippers at the gate ; the veil which conceals

him from us cannot be lifted up, nor could our eyes endure the brightness of his glory.

But how little does Paley seem to think of this, when he reasons of his Maker as if he were a man, and dares to bind up the *great first cause* in the links of a single disjunctive proposition. God, as far as regards the interests of man, must be benevolent, malignant, or indifferent. This is the fundamental proposition of his moral system. But by what right can man set limits to the moral condition of the Almighty?—the creator of a million of worlds, each bound to the others by never-changing laws; and perhaps, also, of a million of intellectual systems, each connected with our own by mysterious relations, conceived in his mind and preordained in his will, yet not revealed to us. In vain we try to comprehend even a single attribute of God; we know him only as he has thought fit to reveal himself, by the law written in the heart—by the laws of the material world—and by the declarations of his word. He may, and does, consult his glory in countless ways we know not of. And is it not the height of arrogance in any creature like ourselves to limit, even in thought, the workings of his power, and to confine the operation of his attributes to such channels only as our language can define and our souls can comprehend?

In the history of moral reasoning, there is not to be found a fundamental proposition more faulty in its principles or more dangerous in its application than the one just considered. Is it not notorious, that scoffing men, reasoning on like grounds and

with like fallacy, have impugned the benevolence of God? have profanely dared to entangle the *great first cause* in a dilemma, pretending to prove, from the misery and desolation they saw around them, that he either wanted goodness or wanted power?

If the fundamental reasoning in Paley's system be unsound, its rule is unsuitable to our nature. If expediency be the measure of right, and every one claim the liberty of judgment, virtue and vice have no longer any fixed relations to the moral condition of man, but change with the fluctuations of opinion. Not only are his actions tainted by prejudice and passion, but his rule of life under this system must be tainted in like degree—must be brought down to his own level: for he will no longer be able, compatibly with his principles, to separate the rule from its application. No high and unvarying standard of morality, which his heart approves, however infirm his practice, will be offered to his thoughts. But his bad passions will continue to do their work in bending him to the earth; and, unless he be held upright by the strong power of religion (an extrinsic power which I am not now considering), he will inevitably be carried down, by a degrading standard of action, to a sordid and grovelling life.

It may, perhaps, be said, that we are arguing against a rule only from its misapprehension and abuse. But we reply, that every precept is practically bad when its abuse is natural and inevitable; that the system of utility brings down virtue from a heavenly throne, and places her on an earthly tribunal, where her decisions, no longer supported by any

holy sanction, are distorted by judicial ignorance, and tainted by base passion. Independently, however, of the bad effects produced on the moral character of man, by a system which makes expediency (in whatever sense the word be used) the test of right and wrong, we may affirm, on a more general view, that the rule itself is utterly unfitted to his capacity. Feeble as man may be, he forms a link in a chain of moral causes, ascending to the throne of God; and, trifling as his individual acts may seem, he tries in vain to follow out their consequences, as they go down into the countless ages of coming time. Viewed in this light, every act of man is woven into a moral system, ascending through the past—descending to the future—and preconceived in the mind of the Almighty. Nor does this notion, as far as regards ourselves, end in mere quietism and necessity. For we know right from wrong, and have that liberty of action which implies responsibility: and, as far as we are allowed to look into the ways of Providence, it seems to be compatible with his attributes to use the voluntary acts of created beings as second causes in working out the ends of his own will. Leaving, however, out of question that stumbling-block which the prescience of God has often thrown in the way of feeble and doubting minds, we are, at least, certain that man has not foreknowledge to trace the consequences of a single action of his own; and hence, that utility (in the highest sense of which the word is capable) is, as a test of right and wrong, unfitted to his understanding, and, therefore, worthless in its application.

By what right, either in reason or revelation, do we assert the simple and unconditional benevolence of God ; and, on this assumption, go on to found a moral system and a rule of life ? If he be a God of mercy, is he not also a God of justice ? Sin and misery are often among the means of bringing about the ends of his providence ; and are so far consistent with his government, that they are permitted to last their time upon the earth. Nor is this all. The authority of any law may be abrogated by the same power that made it : and in the revealed history of the dealings of God with man, acts, which under ordinary circumstances would be crimes of the darkest dye, have more than once been made tests of obedience or conditions of acceptance. Contemplations such as these make the unassisted reason shrink within itself, through pure despair of comprehending the whole moral government of the world. One thing, at least, they do prove—how rash and vain a thing it is, for a feeble and narrow-sighted being like one of us, to construct a moral code on his own interpretation of a single attribute of the Godhead.

A religious man has a happy escape out of all the difficulties of these dark questions. He feels within himself the liberty of choice ; his conscience tells him he is responsible for his actions ; the word of God points out a remedy for the evils which encompass him : he applies the remedy to himself in humble thankfulness, for it meets his wants and is fitted to his capacity ; and, in the terms of his acceptance into the Christian covenant, he finds no condition annexed but the love of God and man.

It may, perhaps, be said, that the moral system of Paley is compatible with the most exalted motives, inasmuch as it takes in the whole Christian sanction of a future state ; and no man, under any reasonable view of morality and religion, can be called on to act in opposition to his eternal interests. Part of this observation may be just ; but it gives no colour of truth to the moral system here considered, unless it can be also shown that our future condition, as revealed to us in the religion of Christ, depends on our following a rule of life measured by the standard of utility. But is this true ? I believe the contrary ; and that *the holiness, without which no man shall see the Lord*, is as different from a temper governed (no matter how consistently) by any worldly rule whatever, as light from darkness.

Christianity considers every act grounded on merely worldly consequences as built on a false foundation. The mainspring of every virtue is placed by it in the affections, called into renewed strength by a feeling of self-abasement—by gratitude for an immortal benefit—by communion with God—and by the hopes of everlasting life. Humility is the foundation of the Christian's honour—distrust of self is the ground of his strength—and his religion tells him that every work of man is counted worthless in the sight of Heaven, as the means of his pardon or the price of his redemption. Yet it gives him a pure and perfect rule of life ; and does not, for an instant, exempt him from the duty of obedience to this rule : for it ever aims at a purgation of the moral faculties, and a renewal of the defaced

image of God ; and its moral precepts have an everlasting sanction. And thus does Christian love become an efficient and abiding principle—not tested by the world, but above the world ; yet reaching the life-spring of every virtuous deed, and producing in its season a harvest of good and noble works, incomparably more abundant than ever rose from any other soil.

The utilitarian scheme starts, on the contrary, with an abrogation of the authority of conscience—a rejection of the moral feelings as the test of right and wrong. From first to last, it is in bondage to the world, measuring every act by a worldly standard, and estimating its value by worldly consequences. Virtue becomes a question of calculation—a matter of profit or loss ; and if man gain heaven at all on such a system, it must be by arithmetical details—the computation of his daily work—the balance of his moral ledger. A conclusion such as this offends against the spirit breathing in every page of the book of life ; yet is it fairly drawn from the principles of utility. It appears, indeed, not only to have been foreseen by Paley, but to have been accepted by him—a striking instance of the tenacity with which man ever clings to system, and is ready to embrace even its most monstrous consequences, rather than believe that he has himself been building on a wrong foundation.*

* The following are the passages here referred to :

“The Christian religion hath not ascertained *the precise quantity of virtue* necessary to salvation.”

“It has been said, that it can never be a just economy of Providence to admit one part of mankind into heaven, and con-

Utilitarian philosophy and Christian ethics have, in their principles and motives, no common bond of union, and ought never to have been linked together in one system : for, palliate and disguise the difference as we may, we shall find at last that they rest on separate foundations ; one deriving all its strength from the moral feelings, and the other from the selfish passions of our nature. Religion renounces this unholy union ; and the system of utility standing by itself, and without the shelter of a heavenly garment not its own, is seen in its true colours, and in all the nakedness of its deformity.

It has, indeed, been said, that all men are governed by selfish motives, and that a Christian differs from a worldly man only in acting on a better calculated selfish rule. I hope that no one whom I am now addressing has been for a moment imposed upon by such flimsy sophistry. The motives on which man acts are not less varied than the faculties of his soul ; and to designate them by one base name (even if done honestly) would only prove an utter confusion of thought or a helpless poverty of language.

If we adopt, as some have done, the notion of absolute moral necessity, we destroy the very foundation of morality : for every moral system, in im-

demn the other to hell ; since there must be very little to choose between the worst man who is received into heaven, and the best who is excluded. And how know we, it might be answered, but that there may be as little to choose in their conditions?" —*Moral Philosophy*, book i., ch. 7.

In the latter years of his life, Paley would, I believe, have been incapable of uttering or conceiving sentiments such as these.

plying responsibility, implies also, at least to a certain degree, the liberty of choice between right and wrong. By the long-continued commission of sin, a man may, however, forfeit the power of self-control—may lose the highest prerogative of his nature, the liberty of soul and body. In such a condition he is said, in the emphatic language of Scripture, to be *given up to a reprobate mind*—to be *in the bonds of iniquity*. But no one comes from his Maker's hands in this condition; he gradually sinks into it by a series of voluntary acts, for which he has himself to blame, and of which he bears within his bosom the accumulated evil.

The determination of the human will has ever been considered a dark and difficult subject of inquiry. One cause of this may be, that it takes place more by passion and affection than by reason; and we should be almost justified in affirming, that the will is never determined by reason only, unless some affection be superadded.* But this destroys

* Locke affirms (*Essay on the Human Understanding*, book ii., chap. 21), that "the motive for continuing in the same state of action is only the present satisfaction in it; the motive to change is always some uneasiness:" and, consistently with this opinion, he goes on to state, "that the most pressing uneasiness naturally determines the will when man is distracted with different desires." Here is a fallacy of like kind with that which has led men to resolve all motives into selfishness. Uneasiness, mental or bodily, is a *powerful motive* in determining the will, but it is not the *only motive*. The passion of maternal love, which urges a mother to caress and protect her child, is surely a feeling very different from the pain which induces a child to withdraw its finger from the flame of a candle. To describe the two feelings by the same term *uneasiness*, tends only to confusion both of thought and word. If the doctrine of Locke be true, a man is in a state of absolute moral necessity—a conclusion, I think, directly contrary to reason and to our own experi-

not the sanctity of moral rule ; for we are clearly as responsible for the exercise of our passions and affections, as for the other faculties of our nature. Whatever may be the clouds first raised by the subtilty of man, and still hanging over certain moral

ence. Again : the doctrine, even in extreme cases, is not true. A man of courage will sometimes endure the protracted torture of a surgical operation without flinching. But no one will surely say, that the remembrance of past suffering or the hope of future good is at the moment a more intense uneasiness than the pain inflicted by the surgeon's knife. In such a case the will is determined by the hope of future good, and directly against the impulse of present uneasiness.

Locke saw clearly that the will is not generally determined by reason pointing out to us the greatest positive good : and he was thence led to the theory above stated ; which, however inadequate to explain all the active principles of our nature, has in it much truth, and ought to have modified several of the opinions advanced in the latter part of his work (book iv., chap. 17, 18, 19). Describing the different grounds of assent, he well distinguishes reason and faith from each other. " Reason is natural revelation, whereby the eternal Father of light communicates to mankind that portion of truth which he has laid within the reach of their natural faculties. Revelation is natural reason enlarged by a new set of discoveries communicated by God immediately ; which reason vouches the truth of, by the testimony and proofs it gives that they come from God." Faith, according to the same author, is the assent to any proposition coming directly from God in the way of revelation. But he forgets that religion is a rule of life, and that faith is worthless unless it influence the will ; yet, on his own system, the will is never determined by a mere perception of the greatest positive good. In short, whatever practical view we take of human nature, faith, in the sense in which the word is used by Locke, is of no use unless there be added to it some of that very element of assent which he condemns under the name of enthusiasm. Without the co-operation of the affections, the influence of Christian rule would soon be extinguished within the bosom—would go out like fire in a damp vault for want of the air of heaven to keep it burning. I have thought it right to point out this inconsistency, because it involves consequences of great importance : and the chapters last referred to are written with an energy and spirit most captivating to the judgment of young minds.

questions, practically we feel that we are free ; and the judgment of conscience declaring to us that we are responsible for our deeds, is recorded in the language and institutions of every civilized nation in the history of the world. If this does not satisfy the metaphysician, it is at least enough for the Christian moralist, whose rule of life is simple, and whose light is clear.

Leaving, however, all dark questions connected with the determination of the human will, let us for a moment consider men as they are, and the obvious motives of their actions. However they may differ in the natural strength or cultivation of their individual powers, there are the same essential elements in all ; and, morally speaking, one man seems to be distinguished from another only by the direction and expansion he has given to his innate faculties, and the governing power he has gained over them. We see one obeying the movements of brute passion—habitually disregarding others, and seeking only his own sensual gratification. In calling such a one selfish, we use a term of unqualified reproach ; and he stands convicted, not merely by our own moral judgment, but by the recorded sentence of every age and country. Another may be selfish in a different way. He may seek some end which his natural feelings and his reason pronounce to be good ; but he seeks that end immoderately, and without reference to the well-being of his fellow-men. Such a man is called selfish when we estimate his life by that perfect rule which tells him to love his neighbour as himself ; or even when we

try his motives by the humble standard exhibited in the conduct of the world ; and in the latter case, though the word selfish be used only in a relative sense, it is still adopted by us as a term of reproach.

But if selfish passions have exercised a predominating influence over the conduct of mankind, there are other motives in our moral nature, leading to acts of self-denial, and to ends connected only with the good of others. Benevolent affection—a desire for the well-being of others, is a natural feeling of the soul, and even the basest of mankind will sometimes manifest its partial influence. It comes not by teaching, for it is perhaps seen as a mere animal instinct : neither is it the fruit of reason or calculation ; for, however choked it may be, in common cases, by our baser passions, and kept down by motives returning only into self, it sometimes becomes a strong predominating feeling, leading us into acts contrary both to reason and our worldly interest. Can we, then, without a gross abuse of words, confound acts originating in benevolent affections with those that spring from brute passions or the lust of worldly gain ? Cruelty and pity, selfishness and generosity, are words in the vocabulary of every tongue ; and are placed there only because they are wanted in the interchange of thought, and in the description of what is ever before us in our commerce with mankind.

All the phenomena of the material world originate in laws of nature, acting either singly or in combination : but to designate all these laws by one

name, so far from contributing to philosophic clearness, would prove in us an utter confusion of thought, and an incapacity for understanding the use of general terms. So also in the immaterial world, the determination of the will takes place in accordance with the laws of man's moral and intellectual nature, and his actions correspond with the passions and affections working within his bosom. But if the actions of man exhibit all the shades of character recorded in written language, then also must the passions and affections be as varied; and to designate them all by one name (hitherto defining only what is base and sordid), would, I think, argue a distorted view of human nature, arising out of moral obliquity or judicial blindness. A utilitarian philosopher acts wisely, indeed, in hiding the deformity of his moral code by confounding the distinctions between right and wrong: and, should his system ever triumph in society, it can only be by defacing the beauty of language, as well as by destroying the moral dignity of man.

How a Christian can resolve all actions into the effects of mere selfish passion, is more than I can comprehend. The Head of the Church, while he had the form of man, showed not in one act the element of selfish feeling. The love of man was the principle of his life—the beginning and the end of his ministration. Are we not told to *walk even as our Saviour walked*—to make his example our rule of life? And is it not true, that the apostles of our religion, warmed by the spirit of their Master, went about doing good—spent their lives in

works of self-denial, recommending themselves as ministers of Christ, *by pureness, by knowledge, by long suffering, by kindness, by the Holy Ghost, by love unfeigned, by the word of truth, by the power of God, by the armour of righteousness on the right hand and on the left ?** To call such men selfish, is to desecrate our language, to blind our moral sense, and to insult all the better feelings of our nature. A man may be saved from the commission of crime through fear—he may do his duty through the hope of reward—but, as the will is ruled mainly by the affections, he cannot go on consistently in the right way unless they be enlisted on the side of his duty : and until he reaches that condition, he is not for one moment in a state of safety, nor do his principles resemble, even in degree, those exhibited by the high examples of Christian love.

Coming down, however, to men as seen in common life, we find that selfish passion too often triumphs over all their better feelings, and desolates the moral aspect of the world. There is no fear that they will ever be too kind or generous : now, at least, all fear is from another quarter. Still it is not true that they act exclusively on a selfish rule. They cannot destroy all those kindly elements of their nature which lead them to mingle their own happiness with that of others. In ordinary cases they act on mixed motives ; and their practical standard of right and wrong is the opinion of their fellow-men. No wonder that worldly minds should take their rule of life from the world's opinion.

* 2 Cor. vi., 6, 7.

And how operative this rule is upon the human heart, may be seen in the patient endurance of the captive savage on the bed of torture—in the courageous acts of which even vulgar minds are capable, when hurried on by the applauding sympathy of those around them—in the fantastic but high-minded chivalry of the middle ages—in the heroic deeds of self-devotion, adorning the history of Greece and Rome. Sentiments of honour, founded on opinion, have ever been among the living springs of national glory ; and should any one doubt their power in our days, he has only to reflect how often the love of life, the suggestions of conscience, and the hopes of the favour of God, have all been swept away before them.

Let me not be misunderstood : I am not commending the law of honour as the rule of a Christian's life ; I am only speaking of its power ; and, while its power exists in society, it is of the utmost consequence that its rule be as elevated as is compatible with its worldly nature. Whatever exalts the national sentiments, and extends the dominion of conscience by working on the better feelings, must practically influence the moral judgments of mankind, and tend to purify the law of opinion. The indirect influence of the religion of Christ has been, in this respect, of inestimable value. It has banished slavery from our houses, thrown a charm over the relations of social life, taught us to abhor, and hardly to name, crimes against society once perpetrated in the light of day, and thrown a thousand links about the bad passions of men, who neither feel its

sanction, nor, for one moment, think of it as a law proclaimed for their acceptance by the mouth of the Almighty. And thus it is that the law of honour, however false and imperfect as a rule of life, has been exalted and purified by the law of God.

If the poet's song inflamed, and the funeral oration sanctified the heroic courage of the citizens of Greece and Rome, they were taught also to believe in the supremacy of conscience, and to regard vice as a violation of the law of their moral nature. A lofty standard of right and wrong was ever set up before them; and, however corrupt their practice, virtue was honoured, at least in word, and was never permitted to pass before their view without its fitting eulogy.

The law of God is indeed written in the heart in characters too plain to be easily misunderstood; and hence, unless when fettered by system or blinded by passion, men have seldom wandered far from the truth in their speculative judgments between right and wrong. *Whatsoever things are true, whatsoever things are honest, whatsoever things are just, whatsoever things are pure, whatsoever things are lovely, whatsoever things are of good report; if there be any virtue, and if there be any praise, think on these things.** This is the language of St. Paul, a man quite as deeply impressed with a conviction of the depravity of our nature as the other apostles; and in fervent zeal and knowledge of mankind superior to them all. Yet does he never shut out the better feelings of the heart—strip us of our power

of natural judgment between right and wrong—or put aside the authority of conscience. - Still less, in speaking of things honest, and just, and pure, and lovely, and of good report, did he for a moment fix their price by a standard of utility, or estimate their worth by any reference to mere worldly good.

Utilitarian philosophy, in destroying the dominion of the moral feelings, offends at once both against the law of honour and the law of God. It rises not for an instant above the world ; allows not the expansion of a single lofty sentiment ; and its natural tendency is to harden the hearts and debase the moral practice of mankind. If we suppress the authority of conscience, reject the moral feelings, rid ourselves of the sentiments of honour, and sink (as men too often do) below the influence of religion : and if, at the same time, we are taught to think that utility is the universal test of right and wrong, what is there left within us as an antagonist power to the craving of passion, or the base appetite of worldly gain ? In such a condition of the soul, all motive not terminating in mere passion becomes utterly devoid of meaning. On this system, the sinner is no longer abhorred as a rebel against his better nature—as one who profanely mutilates the image of God : he acts only on the principles of other men, but he blunders in calculating the chances of his personal advantage : and thus we deprive virtue of its holiness, and vice of its deformity ; humanity of its honour, and language of its meaning ; we shut out, as no better than madness or folly, the loftiest sentiments of the heathen as well as of the

Christian world; and all that is great or generous in our nature droops under the influence of a cold and withering selfishness.

Were it true, that as we grow up to the stature of manhood we cast behind us our passions and affections—that the judgment determining between right and wrong, and the will carrying us into action, are but the measured consequences of abstract reason pointing us to the greatest good; then might the system of utility have some claim to our acceptance. But this is not our moral nature. Our will is swayed by passion and affection: and if we suppress all the kindly emotions which minister to virtue, do we thereby root up the bad passions that hurry us into crime? Incontestably not. On the contrary, we destroy the whole equilibrium of our moral nature, giving to the baser elements a new and overwhelming energy—we *sow the wind and reap the whirlwind*—we unchain the powers of darkness, which, in sweeping over the land, will tear up all that is great, and good, and lovely within it—will upset its monuments of piety, and shatter its social fabric into ruins; and, should this hurricane be followed by a calm, it will be the calm of universal desolation. These are no ideal evils. The history of man is too often but a sanguinary tale of the devastations produced by the license of bad passions.

It is notorious, that no man acts up to the pure rule of his religion—that many are indifferent to it, or openly deny its sanction. In examining the effects of the utilitarian philosophy, we have no right to bind up its maxims with the book of life, thereby

producing an incongruous system, offensive alike to sound philosophy and true religion ; we must try it among men acting on worldly principles, and knowing no higher sanction than the current sentiments of honour ; and, not appealing to extreme instances, but taking men as they are, it may, I think, be confidently stated, that the general acceptance of Paley's moral rule in any Christian society, would inevitably debase the standard of right and wrong. It strikes, indeed, at the very root of the higher virtues, which, in the past history of mankind, have ever been held up to honour as the strong bonds of social happiness and the foundation of national greatness. And, while human nature is what it is, every system that is sterile in great virtues will be fruitful in great crimes. On this truth history is but a continued comment.

If we accept a system of philosophy which looks on actions only as the means to obtain a worldly end, have we not cause to fear that the end will be made to sanctify the means ; and that sensual sin, in its most hideous form, will be endured, or perhaps impudently recommended as a counterpoise to the evils that are wound about our nature, and enter into the very elements of a condition of probation ? Have we not cause to fear that private virtue will, before long, be set at naught, or sink under the domination of selfishness—and that, in the prevailing disbelief in individual honour, public men will become the mere implements for carrying into effect the basest aims of faction ? In such a degraded state of public opinion, bad, unscrupulous, and boast-

ing men may be elevated to places of high authority; and in their hands the fountains of law and justice may become polluted, the sacred cause of liberty bartered or betrayed, and the national faith sacrificed to vanity, to personal interest, and to party violence. When once sunk to this condition, a nation has parted with the materials both of its strength and glory; the very elements of its cohesion are passing away; and, should there not be found ten just men within it to turn away the avenging wrath of Heaven, before long its high places will be laid low, and *its pleasant land will be laid desolate*.

The moral system of utility resolves virtue into a single principle, from which our social duties are all to be evolved as a rational consequence. This simplicity (constituting, in truth, the greatest fault of the system) gave it a ready acceptance in society: for, however impatient man generally is in tracing the unascertained connexion of phenomena, he is never wearied with following out the consequences of an hypothesis. In the latter case, his natural pride is flattered; he stands forth not as a humble seeker after truth, but as a dispenser of the laws of nature; and he looks on every conclusion he deduces from his principles as his own intellectual progeny, to be supported by him at whatever cost.

If a rash spirit of generalization have often retarded the advance of physical science, its consequences are incomparably more baneful in moral reasoning. A false theory in physics affects only our views respecting the connected properties of

dead matter, and may be set right sometimes by a single experiment. But moral theories have no simple *experimenta crucis* whereby their truth or falsehood may be tested; and in their application they may affect the social dignity and the happiness of millions, each gifted with an immortal nature. I am not fighting with ideal evils. Who has not witnessed the effects of false principles carried into the social system? In severe science, a *reductio ad absurdum* drives us at once from a false position. But in moral and political reasoning, a man must be a pitiful advocate whose breast is not hardened against such a weapon, and who, in defending his theory, is not ready to bear up against its most preposterous consequences.

False opinions on moral questions are then not mere idle aberrations of the mind: for they produce a direct, and sometimes an overwhelming influence on the practical judgments of mankind—on all the maxims of society by which men are generally governed. Not, however, to dwell on the strange errors in modern moral speculations, we may, I think, conclude, that utilitarian philosophy, wherever it is received and acknowledged, will teach man to think lightly of the fences the God of nature has thrown around him, and so prepare him for violent and ill-timed inroads on the social system, and for the perpetration of daring crimes.

To return once more to the questions with which I started: I think that to reject the moral sense is to destroy the foundation of all moral philosophy; that the rule of expediency, as stated by Paley, is

based in false reasoning on the attributes of God ; that the rule itself is ill-suited to the capacity of man ; that it is opposed to the true spirit of the Christian religion ; and that, however honestly it may be accepted, it tends inevitably to lower the standard of what is right and good. Lastly, we may, I think, assert, both on reason and experience, that, wherever the utilitarian system (avowedly based on a rejection of the moral feelings, and an abrogation of the law of conscience) is generally accepted, made the subject of *a priori* reasoning, and carried, through the influence of popular writings, into practical effect ; it will be found to end in results most pestilent to the honour and happiness of man.

Having examined at so much length the doctrine of expediency, considered as the foundation of moral light, I shall not dwell long on its application to questions of political philosophy, especially as these subjects form so small a part of a system of academic instruction. I may, however, remark, that as every state is but an assemblage of individuals, each of whom is responsible to moral law, the state itself cannot be exempt from obedience to the same law : and hence, if expediency be not (as I have endeavoured to show) the general test of right in abstract questions of morals, neither can it be the general test of right in questions of political philosophy.

“Right is consistency with the will of God :” and strange must be our notions of the attributes of the Godhead, if we can suppose individual and

national right to be essentially different from each other. We believe that a nation's honour is a nation's strength ; that its true greatness consists in the virtue of its citizens ; and that the decay of principle and the frequency of crime are the sure preludes of its downfall. Truths like these are attested by every chapter in the written history of our race : and what do they prove, except that God is a moral governor of the world ; and, therefore, that, in the end, high principle and sound policy will be found in the strictest harmony with each other ? If, in the probationary condition of the world, nations as well as individuals be sometimes involved in calamities they seem not to deserve, we have no right, on that account, to argue from an exception to a rule, or to deny a general truth attested at once by the voice of history and the repeated declarations of the word of God.

But, if principle and policy be thus in general accordance, may we not admit expediency as the basis of political right ? I reply, incontestably not. All the objections urged against the utilitarian principles of moral philosophy apply with threefold force in questions of national policy : and, for this reason among many others, that men, acting for the state with a divided responsibility, have generally a less elevated standard of right than when acting for themselves. Were utilitarian philosophy ever practically recognised among the leading nations of Europe, bodies of men, already base and sordid, would become more base and more sordid under the shelter of pretended principle ; and national faith and

honour would soon be banished from the world in the public contests of unblushing selfishness.

I have before remarked, that, as a matter of historical experience, religion is essential to the social happiness of man, and, consequently to the well-being of every nation. The Christian religion is, however, of national importance, not merely because it is expedient, but because it is true, and because its truths are of an overwhelming interest to every individual member of the state. It is not my present object to speak either of the proofs or the doctrines of our religion; but I may point out, by-the-way, its humanizing influence on the whole complexion of society. The life and happiness of a fellow-being are, in a Christian's eye, of a thousand-fold more consequence than in the cold speculations of infidel philosophy.

If there be a superintending Providence, and if his will be manifested by general laws operating both on the physical and moral world, then must a violation of those laws be a violation of his will, and be pregnant with inevitable misery; and if it be forbidden to man to "do evil that good may come," for like reason it is forbidden to a nation to seek any end, however great and important it may seem, by evil means. Prudence is, however, a virtue in private life; and a wise regard to utility is indisputably the duty of a state. Truths like these are denied by no one; all we contend for is, that the maxims of utility must ever be held subordinate to the rules of morality and the precepts of religion. And to what does this conclusion lead us?

Only to refer all right to the supreme authority—to look to the will of our lawgiver as our ultimate rule—and to believe that nothing can, in the end, be expedient for man, except it be subordinate to those laws the author of nature has thought fit to impress on his moral and physical creation.

If, in moral reasoning, it be mere mockery to use the language of demonstration, and to build up systems by trains of *à priori* reasoning upon a single principle, it is assuredly not less absurd to affect the forms of inductive proof in political speculation. Every political, as well as every moral principle, practically involves the determination of the will, and thereby becomes at once separated from that class of investigations in which we consider the immutable relations of physical phenomena. That the will is influenced by motives, no one pretends to deny : on that subject enough has been said before : but to compare that influence to a physical cause, followed by an unvaried physical effect, is only to confound things essentially different, and must ever end in metaphysical paradox or practical folly.

Again : discussions on the principles of government are not merely removed from the province of demonstration, but are encumbered with difficulties, peculiarly their own, arising out of the blindness of party spirit or the violence of bad passion. We may argue on the powerful influence of the social affections—we may assume, as a general truth, that man is sufficiently watchful of his worldly interests—we may deduce conclusions from our principles, not as mere abstractions (in which case they would

be little worth), but as results founded in long experience and fortified by numerical details: yet with all this, which may be called an extreme case of moral certainty, do we find men ready to accept our conclusions? Do we not find, on the contrary, that their eyes are shut to every gleam of light not reflected from their own preconceived opinions—that the small voice of truth cannot be heard amid the brawlings of faction—and that reason is compelled to hide her head among the contentions of vulgar passion?

Nor have we yet done with difficulties in the application of abstract political principles. Men are commonly ruled by habit and affection. The love of our friends and of our native land—the love of the institutions under which we have been trained, and which, in common cases, give to the mind its whole stamp and character—a feeling of participation in our country's glory—a veneration for forms of government that are blended with historical recollections: sentiments such as these are honourable and natural to man; and without them, no one, considered as a member of the state, could be a good citizen, nor, as an individual, could he possess either social happiness or moral dignity. Without these feelings, laws would be no more binding than a rope of sand; and the complex and artificial fabric of society would lose its best principles of cohesion, and soon crumble into its first elements.

It is not true that national habits and sentiments are merely the fruit of reason, or that they become confirmed only through an experience of utility.

We might, perhaps, assert, that they are most inveterate when they are least reducible to any rules of abstract reason. Is it not, indeed, true, that in the Eastern world many centuries and dynasties have passed away, while social institutions and habits of thought, to European eyes the most strange and fantastical, have continued to flourish in full ascendancy, as if exempt from that power of time which changes all things else? In the great Christian families of Europe similar institutions and a common religion, have put men more nearly on the same level, and hindered the growth of strongly contrasted national sentiments. Still, whatever be his external condition, there will remain the same original principles in the inner man; and we know, not merely from the evidence of times past, but from the experience of our own days, that civil institutions are not commutable—that a form of government securing peace and happiness in one country, may be followed by anarchy and misery in another—and that sudden changes in any part of the social system, whatever may be their ultimate advantage, are always accompanied by enormous evils. The axe of the despot or the sword of the conqueror may have sometimes succeeded in lopping off all national sentiments, and cutting men down to a common type and pattern. But such a change implies the destruction of every germe of freedom and national honour; it can only be introduced under the dreadful symbols of servitude, and is the sure prelude of misery and moral degradation.

To what, then, are we led by considerations such

as these ? To the belief that all systems of political philosophy based on the doctrines of utility, and deduced by *à priori* reasoning from assumed simple principles (without comprehending all the great elements of man's moral nature, and without, perhaps, even regarding his social condition), are either mischievous or impracticable. Universal systems, like universal nostrums, savour more of political quackery than political philosophy. They are nearly akin to that system of morals which resolves virtue into general benevolence, while it sets at naught the domestic and social affections : and should they hereafter be found applicable to the government of any portion of mankind, it can only be where men have parted with those sentiments and feelings which have hitherto supplied the firmest cement of social happiness and national strength.

In mechanical philosophy we may make what hypotheses we please ; we may theoretically construct an arch, without considering the friction of its component parts, and obtain results which, however unlike anything found in a natural condition of equilibrium, are mathematically true, and are not without their speculative use. But political philosophy, in this abstract form, has no certainty and no value of this kind. Its objects are essentially practical ; and it must be applicable to some real condition of society, or it is worse than nothing. And most strange and mischievous is that philosophy which, in considering the stability of a state, overlooks that moral friction whereby its social elements are kept in their true position.

Perhaps it may be said that the preceding observations are mere truisms denied by no one. But, practically, they have too often been contradicted or overlooked ; and more, I believe, in modern than in ancient times.

A wide examination of such facts as throw light on the statistical history of mankind, and a laborious observation of the causes regulating the accumulation and distribution of national wealth, are among the circumstances by which modern political philosophy has been most distinguished: and as we believe that the knowledge of truth will always, in the end, minister to the honour and happiness of man, we must, as honest lovers of our neighbour, rejoice in the progress of economical science. The economist is mainly employed in observing and classifying phenomena, from which he deduces consequences that are to him in the place of moral laws. The legislator, on the contrary, assumes the principles he carries into action, applies them to a given condition of society (perhaps never contemplated by the economist), and anticipates the results of moral causes working on new social combinations. Under this view, the position of the two philosophers is seen in the strongest contrast. The one, like the early observers of the heavens, marks the phenomena out of which he endeavours to trace the relative position and movements of the great bodies of the social system. The other, more like the physical astronomer, not merely takes for granted all the great movements of the political fabric, but, combining with this a knowledge of the perturbations proceed-

ing from the mutual actions of its parts, dares to look into futurity, and to speculate on events that time may hereafter bring to light within the world he contemplates. The labours of the one belong chiefly to the elements of political philosophy, the labours of the other belong to its consummation.

The great objects with a wise legislator are the security of the state and the happiness of its subjects. But national wealth (in however extended a sense the term may have been used) is, after all, but one of the means of securing these great ends. And among the greatest blunders the economist has committed, has been a hasty spirit of generalization (and what infant science has not suffered by that spirit?), an affectation of deductive reasoning, and a rash attempt to usurp, before his time, the chair of the lawgiver. Political economy has, however, now a permanent place among the applied moral sciences, and has obtained an honourable seat in most of the academic establishments of the civilized world. Surely, then, we may dare to hope (without being accused of rashness in counting on the coming fortunes of mankind), that it may, in the end, assist in enabling men to see more deeply into the sources of social happiness or national greatness; that it may allay the bitterness of national animosity; teaching kingdoms, as well as individuals, how much they gain from mutual support and mutual good-will; and, more than all, that it may (when combined with Christian knowledge) help to lighten the pressure of such evils as belong to our fallen nature, and are among the unavoidable conditions of our probation.

No one denies that the moral and political characters of men are, in a great measure, formed by the institutions under which they live ; and were it asked whence these institutions derive their permanency and power, we might reply, in general terms, only from being well fitted to the social condition of the state. But if we take an historical view of this great question, we shall see more deeply into the origin of national sentiments. We shall generally find that national character has not been formed merely by national institutions ; but, on the contrary, that the institutions themselves (so far as they are peculiar and permanent) have, for the most part, taken their original form and impress from the moral condition of the state ; that they have grown with its growth ; that they have, like the external covering of the bodily frame, been secreted from its life-blood ; and that they are the representatives of opinions and feelings called into being from time to time, and too often during successive ages of conflict and struggle. Happy is that country which is rising in the moral scale of nations, and where the constitution contains within itself a provision for the perpetual adaptation of its institutions to the healthy movement of the state ! Laws, like those of the Medes and Persians, which alter not, must soon be followed by premature decay, by secret crimes, or bloody revolutions—the sure attendants of unbending despotism.

Lastly, before I quit the subject of political philosophy, let me endeavour to impress upon you the great truth, that no human system can bring the re-

bellious faculties of man under the law of obedience, and that no external change of government whatsoever can make him even approach towards a state of moral perfection—an idle dream of false philosophy, contradicted by all the records of mankind, and directly opposed to the word of God. In the latter part of the last century there existed a large body of men calling themselves philosophers, the best of whom (as they were seen in a neighbouring kingdom) might be described under the name of *moral fanatics*: for with all the evils they helped to bring upon the world, they still dreamed of doing good. In the internal government of the kingdoms of Europe they saw enormous evils; sufficiently accounting, on their theory, for all the wickedness and misery they saw around them. Hence, they sought not merely to improve, but to remodel the whole social fabric of the world; and they looked forward to a time of moral perfectibility, when the image of philanthropy was to be set up in the high places of the earth, and *all the people, the nations, and the languages, were to fall down and worship it*. Unhappily for themselves and for their country, the leaders of this school of fanaticism were, almost without exception, sunk in infidelity. Had they accepted, even in the humblest degree, the doctrines of the religion of Christ, they never could have made such portentous errors in estimating the moral character of man. With all the sanctions of religion, the terrors of the law, and the numerous links thrown round him by the domestic and social affections, how hard is it to keep him in the right way! And

if we free him from these complicated bonds, there is nothing left for him but the base servitude of brutal and selfish passion.

Errors like those just pointed out are not, perhaps, likely ever to rise again into political importance, although they may long continue more or less to taint the speculations of one school of moral and political writers.

IV. RELATION OF RELIGIOUS AND NATURAL STUDIES.

A study of the laws of nature has long been, and I hope ever will be, held up to honour in our course of academical learning. But in this, as in every other field of labour, no man can put aside the curse pronounced on him—that by the sweat of his brow he shall reap his harvest. Before he can reach that elevation from whence he may look down upon and comprehend the mysteries of the natural world, his way is steep and toilsome, and he must read the records of creation in a strange, and, to many minds, a repulsive language; which, rejecting both the sense and the imagination, speaks only to the understanding. But when this language is once learned, it becomes a mighty instrument of thought, teaching us to link together the phenomena of past and future times; and gives the mind a domination over many parts of the material world, by teaching it to comprehend the laws by which the actions of material things are governed. To follow in this track, first trodden by the immortal Newton—to study this language of pure, unmingled truth, is to be regarded not

only as our duty, but our high privilege. It is no servile task, no ungenerous labour. The laws by which God has thought good to govern the universe are surely subjects of lofty contemplation; and the study of that symbolical language by which alone these laws can be fully deciphered, is well deserving of our noblest efforts. Studies of this kind not merely contain their own intellectual reward, but give the mind a habit of abstraction, most difficult to acquire by ordinary means, and a power of concentration of inestimable value in the business of life. Were there any doubt of this, I would appeal to modern examples, and point out a long list of illustrious men, who, after being strengthened by these severe studies, and trained in their discipline, have borne off the prize in the intellectual conflicts of their country. But I need not attempt to prove what no one is prepared to deny.

Are there, however, no other consequences of these studies beyond those I have pointed to? The moral capacities of man must not be left out of account in any part of intellectual discipline. Now these severe studies are, on the whole, favourable to self-control: for, without fastening on the mind through the passions and the senses, they give it not merely a power of concentration, but save it from the languor and misery arising from vacuity of thought—the origin of perhaps half the vices of our nature.

Again: the study of the higher sciences is well suited to keep down a spirit of arrogance and intellectual pride; for, in disentangling the phenomena

of the material world, we encounter things which hourly tell us of the feebleness of our powers ; and material combinations so infinitely beyond the reach of any intellectual analysis, as to convince us at once of the narrow limitation of our faculties. In the power of grasping abstract truth, and in the power of linking together remote truths by chains of abstract reasoning, we *may* be distinguished from the lower orders of the beings placed around us ; but, in the exercise of these powers, we bear, perhaps, no resemblance whatsoever to the supreme intellect. Applied to an Almighty Being, with the attribute of ubiquity, in whose mind all things past and to come coexist in eternal presence, time and space have no meaning ; at least, in that sense in which they are conditions of our own thoughts and actions. To him all truth is as by intuition : by us truth is only apprehended through the slow and toilsome process of comparison. So that the powers and capacities, forming the very implements of our strength, are also the indications of our weakness. In some of our capacities, we may perhaps exhibit a faint shadow of a portion of our Maker's image ; but, in the reasoning power, of which we sometimes vainly boast, we bear to him, I believe, no resemblance whatsoever.

Simplicity of character, humility, and love of truth, ought, therefore, to be (and I believe generally have been) among the attributes of minds well trained in philosophy. After all that has been done since the thoughts of man were first turned to the phenomena of the material world—after all the boasted discov-

eries of science, from the first records of civilization down to our own days—those glorious passages of the Old Testament, contrasting the power and wisdom of God in the wonders of his creation, with man's impotence and ignorance, have still, and ever will continue to have, not merely a figurative or poetical, but a literal application. *Gird up now thy loins like a man : for I will demand of thee, and answer thou me.* Where wast thou when I laid the foundations of the earth ? Declare, if thou hast understanding . . . Whereupon are the foundations thereof fastened ? or who laid the corner-stone thereof ; when the morning-stars sang together, and all the sons of God shouted for joy ? Or who shut up the sea with doors, when it brake forth, as if it had issued out of the womb ? When I made the cloud the garment thereof, and thick darkness a swaddling band for it . . . and said, Hitherto shalt thou come, but no farther : and here shall thy proud waves be stayed ? . . . Where is the way where light dwelleth ? and as for darkness, where is the place thereof ? . . . Knowest thou it, because thou wast then born ? or because the number of thy days is great ?*

Before such an interrogator we can only bow in humble adoration. The study of the laws of nature may strengthen and exalt the intellectual powers ; but strange must be our condition of self-government, and tortuous our habits of thought, if such studies be allowed to coexist with self-love, and arrogance, and intellectual pride.

A study of the Newtonian philosophy, as affect-

* Job, chap. xxxviii.

ing our moral powers and capacities, does not terminate in mere negations. It teaches us to see the finger of God in all things, animate and inanimate, and gives us an exalted conception of his attributes, placing before us the clearest proof of their reality ; and so prepares, or ought to prepare, the mind for the reception of that higher illumination, which brings the rebellious faculties into obedience to the divine will.

We learn by experiment the different actions and relations of material things around us, and we find them bound together by a law of mutual attraction. Following our master of philosophy in the loftiest generalization recorded in the history of mankind, we attribute this property, found in the matter on the surface of our planet, to every other mass of matter within the limits of the visible universe. We bring our generalization to the test of observations of a new and certain kind, and we find that it is true. We find that no parts of the visible universe are insulated from the rest, but that all are knit together by the operation of a common law. We follow this law into its remotest consequences, and we find it terminating in beauty, and harmony, and order.

[In order to understand the nature and importance of Newton's discoveries, we must remember that, in the preceding century, the Copernican system had been promulgated ; and that Kepler, after incredible labour, had established the following general propositions, on the evidence of direct observations.

1. That if each planetary orbit be considered as a

space traced out by a line drawn from the sun to the revolving body, this line traces out equal successive areas in equal successive times.

2. That the planets move in elliptical orbits, having the sun in a common focus.

3. That the squares of the times of revolution of the several planets, and the cubes of their mean distances from the sun, are in a fixed proportion to each other.

It must also be admitted, that, before the discoveries of Newton, there was current in the philosophic world a vague and general notion of some material action of the planets on each other. No one, for example, doubted that the tides were some how or other influenced by the moon : and, perhaps, no one who had adopted the Copernican system, and speculated on the nature of mechanical motion, could doubt that the planets were affected by some action or power emanating from the sun. Before the time of Newton, no one had, however, ventured to promulgate any definite or numerical law of gravitation : still less had any one, on the assumption of a definite law, demonstrated a single fundamental proposition in astronomy. What had been done by preceding philosophers, takes no more from the glory of Newton than the predictions of Seneca take away from the honour of Columbus.

If any one anticipated Newton in the application of the law of gravitation to the system of the universe, it was Kepler, and not Hook, as has been sometimes erroneously asserted. Hook did not demonstrate a single fundamental proposition in as-

tronomy ; and Newton, I believe, preceded him in the very speculations on which his claims have been sometimes set up. For we must remember that Newton, when a very young man, had just notions of the nature of a central force ; and that he endeavoured to prove, by calculation, that the moon was held in her orbit by the sole force of the earth's attraction ; and failed only because the distance of the moon had been falsely estimated by practical astronomers. Leaving, however, mere historical discussion, let us consider one or two of the early steps of his philosophic progress.

He first appeared as the improver of the elements of mechanical philosophy, giving the laws of motion a generality they had not before, and extending their application to the investigation of motions arising from the combined action of many forces. Starting, then, with the laws of motion (which, in the first instance, may be regarded as an enunciation of certain material phenomena ascertained by direct experiment), his next grand generalization led him to extend these laws to all the bodies of the solar system ; and, combining this assumption with the first proposition of Kepler (above quoted), he at once demonstrated, that the planetary bodies are retained in their orbits by a force tending to the centre of the sun. Combining, then, this demonstrated truth with the second proposition of Kepler (above quoted), he then went on to prove, by a new and most refined geometry, that the force emanating from the sun must vary inversely as the square of the distance from its centre ; or, in other words, must diminish

in the exact proportion in which the square of the distance increases. Having once established this great truth, he then proved that the third proposition of Kepler was a necessary consequence of the demonstrated law of central force. Nothing can be conceived more perfect than this induction : which, starting with laws ascertained by observation, ascended by successive demonstrations, and proved that the most striking phenomena of the solar system were necessary truths involved in the operation of one single mechanical law.

By a similar train of demonstrative reasoning, Newton proved that the planets act on the several satellites revolving round them, according to the same law by which the sun acts on them ; and that the moon is retained in her orbit by the same power which, on the earth's surface, brings a heavy body to the ground. Generalizing the truths at which he had so far arrived by demonstrative reasoning, and asserting of gravitation only what was known of its nature by direct experiment at the earth's surface, he proved, that the centre of each planet may be considered as a distinct centre of a force, not primarily impressed upon the centre, but derived, as a secondary phenomenon, from the combined action of every particle composing the planetary mass ; and he also demonstrated (with a skill almost supernatural, considering the feeble instruments at that time placed within his hands), that the irregularities of the moon's motions are necessary consequences of the universal law of material action.

Again : knowing, as a matter of fact, that the plan-

ets are not perfect spheres, he proved that their forms are necessary effects of his own theory : and, combining these conclusions with the law of universal gravitation, he proved, by most subtle calculations, that certain irregularities in the annual motion of the earth (producing the phenomena of equinoctial precession) are the necessary consequences of the sun's action on the mass of a spheroidal body.

In tracing out the consequences of the law of gravitation, and explaining the minute secular inequalities of the heavenly bodies, much, no doubt, was left by him unfinished. But he had lighted the way for those who were to follow—had given them the key whereby the mysteries of the kingdoms of nature were to be unlocked, and had laid the foundations of every part of that superstructure, which has been since reared only by the united labours of the philosophic world.

The refined geometry of Newton, however beautiful as a mode of exhibiting known truths, is now thrown aside as an implement of discovery. "It was like the bow of Ulysses, which none but its master could bend;" and the difficult questions of physics are now assailed by weapons of greater power.* We must not, however, forget, that he was a great inventor in pure mathematics : and, though he had not made a single optical experiment, nor taken a step in expounding the laws of the material world, he would still have an exalted place in the philosophic history of man.

* Discourse on the Study of Natural Philosophy, by Sir John Herschel, p. 273.

Of the theory of universal gravitation, in the form it has at length assumed, it is not too much to say, that it can be changed by no hand but that which first impressed on matter the laws whereby it continues to be governed. Should man be ever permitted to ascend to some higher universal law, binding together the phenomena of light, heat, magnetism, and all the other subtle agents of our system, still no part of the foundations of physical astronomy would be shaken ; and the utmost change to be introduced into it would be a trifling modification of the mere language of some of its propositions.]

Again : if we commence our examination of the natural world with the small portions of matter which surround us, and, following our induction in a new direction, resolve them into their elements, and unravel the laws of their combination, we see at every step new cause for wonder—new objects for admiration. Every portion of the matter we tread beneath our feet (however insignificant as an object of sense), propagates its influence through all space, and is felt in the remotest regions of the universe. However small the particle of dust we trample on, it may present traces of a mechanism subservient to the complicated functions of a living being ; or it may be a compound inorganic body, possessing properties of indefinite complexity : and, though it be what we call a simple substance, still it is held together by its own laws of cohesion ; it is composed of elements not brought together fortuitously, but in obedience to a fixed law, by which they are congregated in definite proportions, and grouped in sym-

metry and order. Not only is every portion of matter governed by its own laws, but its powers of action on other material things are governed also by laws subordinate to those by which its parts are held together. So that, in the countless changes of material things, and their countless actions on each other, we find no effect which jars with the mechanism of nature, but all are the harmonious results of dominant laws.

Again : if we pass from the consideration of things visible and tangible to the subtle and imponderable agents of the material world, we not only witness the manifestation of their powers in every physical change and every combination, but we know that some of them, and we may perhaps suppose that all of them, are diffused uninterruptedly through every portion of the universe. We are certain that the material of light is, at least, as far extended as the force of gravitation. It places us at once in physical contact with the remotest bodies of our created system ; and, by its vibrations, they become manifest to us through our visual sense. There is, therefore, no portion of space, however small or however distant, which is not filled at all times with subtle matter—which does not every moment transmit material influences, in number, complexity, and rapidity beyond the grasp of thought ; yet never anomalous or fortuitous, but governed by fixed laws, subservient to ends most important in the economy of nature, and essential to the very existence of sentient beings.

[Let us suppose a sentient being sustained in any part of our system which is not occupied by the

grosser matter of the planetary bodies, and endowed with a power of sight as great as is our own, when assisted by the best telescope yet invented. To such a being, all the bodies of our system would at once become visible, and the firmament around would be seen by him, glittering with the light of many million stars. But we must remember that each of these shining points is seen only through the intervention of a beam of light sent down by it directly to the eye. There is, therefore, not a single point in the empty spaces of our system, through which millions of beams of light do not pass unceasingly, yet with a material action so subtile that one beam interferes not with another, but each passes onward, as if moving by itself—the sole messenger from the centre of light to the sentient beings of the universe.

In general considerations like these, the mind seems to lose its power, and becomes almost bewildered: and if we call in the aid of calculation, though we build on demonstration, and clothe our results in numbers, our conclusions seem, perhaps, more than ever removed from the grasp of sense. If we accept the theory (considered by some of those who have most deeply studied it, as well established as the theory of gravitation) which derives the sensation of sight from vibrations propagated through an elastic ether by the visible object to the eye, then is each beam of light but a part of a distinct system of vibrations, every wave of which diverges through space with a sustained velocity sufficient to carry it eight times round the earth in a

single second, and each wave is followed by another at so short an interval, that 100,000 of them are packed within the space of every inch. Millions of such systems of vibrations pass, then, unceasingly through every point of visible space, yet without disorder and confusion; so that each system of waves goes on unobstructed by the others, preserving the individual powers impressed upon it, and through them ministering to the wants of millions of sentient beings.

Our knowledge of the complicated fabric of the material universe (even in those parts we sometimes describe as mere vacuities) does not end here. There is not a point in any portion of our system through which millions of material influences (implied, indeed, in the law of universal gravitation) are not constantly transmitted. That they differ from the subtile material action last considered is certain; yet no one will deny that they belong to some mode of material action, though he knows nothing of the mechanism whereby they are propagated and maintained.

Had there been any extended vacuities in the universe, it might, perhaps, have been said that such portions of space were without any manifestation of the Godhead. But what has been stated is enough to show, that there are no such places within the ken of our senses or the reach of our thoughts. That God is everywhere is the language of revealed religion; that God manifests his power everywhere is in like manner the voice of natural religion, spoken through the universal domination of material laws.]

In speaking of the laws of nature, and of the harmonious changes resulting from their action, in spite of ourselves we fall into language in which we describe the operations of intelligence : and language, let me observe, was never formed by a convention of learned men, or constructed on the scheme of an hypothesis. It is the true offspring of our intellectual nature, and bears the image of such ideas as rise up of necessity in the mind, from our relation to the things around us. If we forget Him in our thoughts, with our lips, at least, we must do homage to the God of nature. What are the laws of nature but the manifestations of his wisdom ? What are material actions but manifestations of his power ? Indications of his wisdom and his power coexist with every portion of the universe. They are seen in the great luminaries of heaven—they are seen in the dead matter whereon we trample—they are found in all parts of space, remote as well as near, which we in our ignorance sometimes regard as mere vacuities—they are unceasing—they are unchangeable.

Contemplations such as these lift the soul to a perception of some of the attributes of God ; imperfect it may be, but still suited to the condition of our being. But are thoughts like these to pass through the mind and produce only a cold acquiescence ? Are we to dwell in the perpetual presence of God, and yet dishonour him by the worship of ourselves, and refuse to him the homage of our humble praise ? Such were not the feelings of the holy Psalmist, when, contrasting his own feebleness

with the all-pervading wisdom and power of God, he was kindled as by fire from heaven, and burst out into rapturous expressions of adoration. *Whither shall I go from thy spirit? or whither shall I flee from thy presence? If I ascend up into heaven, thou art there: if I make my bed in hell, behold, thou art there. If I take the wings of the morning, and dwell in the uttermost parts of the sea; even there shall thy hand lead me, and thy right hand shall hold me. If I say, Surely the darkness shall cover me; even the night shall be light about me. Yea, the darkness hideth not from thee: but the night shineth as the day: the darkness and the light are both alike to thee.**

How any believer can deny the reality of a natural religion, when he reads those passages in the Bible where its power is so emphatically acknowledged, is more than I can understand. We are told by St. Paul, that even the Gentiles are without excuse, *for the invisible things of God from the creation of the world are clearly seen, being understood by the things which are made, even his eternal power and Godhead.†* Yet I have myself heard it asserted, that there is no religion in nature; and that we have no knowledge of the attributes of God, or even of his existence, independently of revelation. The assertion is, I think, mischievous, because I believe it untrue: and by truth only can a God of truth be honoured, and the cause of true religion be served.

* Psalm cxxxix 7 12.

† Rom. i., 23.

But there is another class of objectors, who not only adopt this cold and unnatural conclusion, but, rejecting revelation along with it, banish utterly all thought of God from the world. It is indeed true, as these objectors state, that all material changes are governed by fixed laws, and that the present condition of all material things is but a natural consequence of these laws, operating on that condition of matter which preceded the phenomena we contemplate. They rest their strength, as far as I understand their meaning, in this immutability of the laws of nature, and having, with much labour, deciphered a portion of these laws, and having traced the ordained movements of the material world, without ever thinking of the Being by whom these movements were directed, they come at length to deify the elements themselves, and to thrust the God of nature from his throne. But where is the reasonableness of this conclusion? The unchangeableness of the laws of nature is not only essential to the well-being, but to the very existence of creatures like ourselves. The works of our hands are liable to perpetual change, from caprice, from violence, or from natural decay : but, in the material laws ordained by God, there are no such indications, because they partake of the perfections of his attributes, and are therefore unchangeable.

The single-minded writers of the New Testament, having their souls filled with other truths, thought little of the laws of nature : but they tell us of the immutable perfections of our heavenly Father, and describe him as a being in *whom is no*

variableness or shadow of turning. The religion of nature and the religion of the Bible are therefore in beautiful accordance ; and the indications of the Godhead offered by the one, are well fitted to give us a livelier belief in the promises of the other. So far from offering any foundation for an atheistical argument, the constancy of the laws of nature might, I think, have been almost anticipated by a well-ordered mind, though unacquainted with the great discoveries of physics : and, should the framer of the universe have other changes in reserve for the material world beyond those that follow from the laws by which he has already in part revealed himself to us, we have no right to suppose that such changes can be known or understood by beings like ourselves—so feeble in capacity—so limited in time—and confined to such a speck of the universe.

But, after all, we do contemplate something more than a mere succession of material changes. We find that these changes are limited by an adjusting power, and tend to a condition of equilibrium, and that the ultimate results of the laws of nature are harmony and order. We find them operating in different portions of space with endless complexity, and yet producing effects perfectly adapted to each other. We see innumerable portions of matter not only obeying laws common to all matter, but acted on by new laws subservient to vital powers ; and by these laws gradually moulded into a beautiful form and mechanism—suited at once to all the complicated functions of a sentient being, and to all

the material elements which surround it. Are we to believe that there can be such beautiful and harmonious movements in the vast mechanism of nature, and yet think that the spirit of God hath not brooded over them, and that his hand hath not guided them? Can we see in every portion of the visible world the impress of wisdom and power, and yet believe that these things were not foreseen in the Divine mind, and these ends not contemplated before he called the universe into being?

The external world proves to us the being of a God in two ways; by addressing the imagination, and by informing the reason. It speaks to our imaginative and poetic feelings; and they are as much a part of ourselves as our limbs and our organs of sense. Music has no charms for the deaf, nor has painting for the blind; and all the touching sentiments and splendid imagery borrowed by the poet from the world without, would lose their magic power, and might as well be presented to a cold statue as to a man, were there no preordained harmony between his mind and the material things around him. It is certain that the glories of the external world are so fitted to our imaginative powers as to give them a perception of the Godhead and a glimpse of his attributes; and this adaptation is a proof of the existence of God, of the same kind (but of greater or less power, according to the constitution of our individual minds) with that we derive from the adaptation of our senses to the constitution of the material world.

The heavens declare the glory of God, and the

*firmament showeth his handiwork.** Here is a direct assertion ; an appeal to the heart, and not to the understanding ; and every unsophisticated heart will beat in unison with it. *The fool hath said in his heart, There is no God : corrupt are they, and have done abominable iniquity.†* In this passage the denial of God is coupled in the mind of the sacred poet with foul and sensual sin. And is not such a union justified by experience ? A soul corroded by sensual sin can ill reflect the pure image of God—can ill discern the indications of his will in the glories of his creation.

Leaving, however, the proofs of an intelligent cause, from the connexion between the external world and our imaginative powers, let us once more glance our eye over the proofs which appeal to the reasoning faculties. The mind becomes bewildered among the countless movements continually going on, and the perpetual changes produced by material actions, of which we see neither the beginning nor the end : but we find repose in the study of animated nature. Every being possessing life may first be considered apart from the rest of nature. Its bodily organs are produced by powers of vast complexity, and understood only in their effects ; confined in their operation to the individual being, and entirely separate from the ordinary modes of atomic action. Yet these organs, thus elaborated, exhibit throughout a perfect mechanism, in all its parts (as far as we can comprehend them) exactly fitted to the vital functions of the being. Contri-

* Psalm xix., 1.

† Psalm liii., 1.

vance proves design: in every organic being we survey (and how countless are the forms and functions of such beings!) we see a new instance of contrivance and a new manifestation of an intelligent superintending power.

This proof is so strong that it never has been and never can be gainsaid. It is in vain that we attempt to shut out the belief in an intelligent Creator, by referring all phenomena to a connected succession of material causes, not one of which is fully comprehended. This thought should indeed fill us with deep humility, but takes not from us the fair inductions of our reason. We do not understand that complicated material action by which the God of nature builds up the organic structure of a sentient being; but we do, in part at least, comprehend the adaptation of its mechanism to various ends, and we see those ends accomplished; and this is enough to warrant our conclusion.

An uninstructed man sees a piece of mechanism, and, from the form and the acting of its external parts (though he comprehend neither its whole structure nor its objects), is certain that it is the work of a skilful hand. Another man understands all its complicated movements, but knows not the nature of the moving power in which they originate. A third can explain the alternate expansions and condensations of an elastic vapour, and point out this action as the origin and support of the whole propelling force. At length we find one who will not only explain the whole mechanism from first to last, but tell us of the nature of its materials, of the

places whence they were derived, of the modes of their fabrication, of the manner in which they were put together, and of all the effects of their combined action. But it is not necessary to know all this to be certain of an intelligent contriver. The first observer drew this conclusion rightly from what he saw, though he comprehended little of these complicated movements. And, after all, what relation does the most skilful mechanist bear to his own workmanship? He does not create one particle of matter, he does not supersede one law of nature: but, using the matter created to his hands, and forming and combining it in subordination to the laws impressed on it, he produces a connected succession of material actions, and obtains a series of results—foreseen in his own mind and determined in his will before he commenced the building of his fabric.

Something like this we can trace in the development of organic beings. They are formed of matter which was created and governed by its own laws anterior to their existence: they are matured by a regulated succession of material actions; when perfected, they exhibit an exquisite combination of mechanical contrivances, and organs fitted to carry them into effect. To such a structure are superadded vital functions and appetencies, which (like the moving force of a complicated engine) put all its parts into motion, and compel them to obey the laws of their destination. The external forms of organic bodies we can study, their functions we can observe, their internal mechanism we can partly trace: but when we consider the vital powers con-

nected with their origin and development, we find ourselves among phenomena out of the ken of our senses, and removed beyond our intellectual grasp, and are compelled to acknowledge our utter ignorance. But on this account to exclude an intelligent contriver, would not be more wise than for a man to assert the fortuitous concourse of the wheels of a machine, because he knew not the power by which it was set in motion.

It is in vain that we attempt to banish an intelligent Creator, by referring all changes, organic and inorganic, to a succession of constant material actions, continued during an eternity of past time. Were this true, it would not touch our argument : and every clear instance of organic contrivance or material adaptation would be a phenomena unexplained, except on the supposition of a contriver. It would only prove that, in a certain portion of space, God had thought fit to give a constant manifestation of his wisdom and power through an indefinite period of duration. The eternity of material forms is, however, but a dream of false philosophy, unfounded in reason or analogy ; and as far, at least, as organic nature is concerned, contradicted by the plainest physical records of the past world.

Assuming, then, that the structure of every being endowed with life demonstrates the existence of an intelligent, overruling power, to what more does the conclusion lead us ?—To the inevitable belief that all inanimate nature is also the production of the same overruling intelligence. As all parts of matter are bound together by fixed and immutable laws,

so all parts of organic nature are bound to the rest of the universe by the relations of their organs to the world without them. If the beautiful structure of organic bodies proves design, still more impressive is the proof when we mark the adaptation of their organs to the condition of the material world. By this adaptation we link together all nature, animate and inanimate, and prove it to be one harmonious whole, produced by one dominant intelligence.

The organs of sense and the materials around them are related to each other in the way of adaptation, but not in the way of cause and effect. The eye is not formed by the vibrations of light, nor the ear by the pulsations of the air. Had this been the case, such beings as the blind and deaf would never have been heard of; for no being can be removed from the influence of those elements. The eye and the ear are formed in the womb by the mysterious operations of organic secretion and assimilation, before the pulsations of the air have ever reached the ear, or the vibrations of light have ever acted on the visual sense. They are examples of beautiful mechanism demonstrating design; but they are adapted only to a future condition of the being, and so also demonstrate a provident intelligence. Should any one deny conclusions such as these, I can only reply, that his mind is differently constituted from my own, and that we have no common ground on which to build a reasonable argument.

By the discoveries of a new science (the very name of which has been but a few years ingrafted on our language), we learn that the manifestations

of God's power on the earth have not been limited to the few years of man's existence. The geologist tells us, by the clearest interpretation of the phenomena which his labours have brought to light, that our globe has been subject to vast physical revolutions. He counts his time, not by celestial cycles, but by an index he has found in the solid framework of the globe itself. He sees a long succession of monuments, each of which may have required a thousand ages for its elaboration. He arranges them in chronological order; observes on them the marks of skill and wisdom, and finds within them the tombs of the ancient inhabitants of the earth. He finds strange and unlooked-for changes in the forms and fashions of organic life, during each of the long periods he thus contemplates. He traces these changes backward through each successive era, till he reaches a time when the monuments lose all symmetry, and the types of organic life are no longer seen. He has then entered on the dark age of nature's history, and he closes the old chapter of her records.—This account has so much of what is exactly true, that it hardly deserves the name of figurative description.

Geology, like every other science when well interpreted, lends its aid to natural religion. It tells us, out of its own records, that man has been but a few years a dweller on the earth; for the traces of himself and of his works are confined to the last monuments of its history. Independently of every written testimony, we therefore believe that man, with all his powers and appetencies, his marvellous

structure and his fitness for the world around him, was called into being within a few thousand years of the days in which we live—not by a transmutation of species (a theory no better than a phrensied dream), but by a provident contriving power. And thus we at once remove a stumbling block, thrown in our way by those who would rid themselves of a prescient first cause, by trying to resolve all phenomena into a succession of constant material actions, ascending into an eternity of past time.

But this is not the only way in which geology gives its aid to natural religion. It proves that a pervading intelligent principle has manifested its power during times long anterior to the records of our existence. It adds to the great cumulative argument derived from the forms of animated nature, by showing us new and unlooked-for instances of organic structure adjusted to an end, and that end accomplished. It tells us that God has not created the world and left it to itself, remaining ever after a quiescent spectator of his own work: for it puts before our eyes the certain proofs, that, during successive periods, there have been not only great changes in the external conditions of the earth, but corresponding changes in organic life; and that in every such instance of change, the new organs, as far as we can comprehend their use, were exactly suited to the functions of the beings they were given to. It shows intelligent power not only contriving means adapted to an end, but, at many successive times, contriving a change of mechanism adapted to a change of external conditions; and

thus affords a proof peculiarly its own, that the great first cause continues a provident and active intelligence.

I forbear to dwell on other questions deeply connected with this science—proofs of a higher temperature, as shown by the organic forms of the old world—indications of the same thing, in the crystalline structure of the lower strata, and the masses on which they rest—and farther proofs derived from the figure of the earth itself. The spheroidal form of the earth seems to have preceded all geological phenomena, and makes probable the condition of primeval fusion : and, following in the same train of thought, we have only to imagine another accession of heat, and the whole earth must have been dissipated through planetary space, and have appeared (were there then an eye like our own to behold it) as a mere expanded nebulosity.

Speculations like these, starting at least from actual phenomena, are not without their use. For, without lowering one jot the proof of a preordaining intelligence, they point, through a long succession of material changes, towards a beginning of things, when there was not one material quality fitted to act on senses like our own ; and thus they take from nature that aspect of unchangeableness and stern necessity, which has driven some men to downright atheism, and others to reject all natural religion.

If, then, our planetary system was gradually evolved from a primeval condition of matter, we may well believe that every material change within

it, from first to last, has been but a manifestation of the Godhead, and an emanation from his immediate will ; or we may suppose that new powers have, by an act of creative interference, been impressed on it at successive epochs of its changes ; and that these new powers, working together with the old, *may* have brought about the next system of material conditions ;* or, if it be thought more in conformity with what we see of the modes of material action, to suppose that the primeval system contained within itself the elements of every subsequent change, then is the primeval matter to the matured system of the world as the seed to the plant, or the egg to the living creature. Following for a moment the last of these hypotheses—shall this embryo of the material world contain within itself the germe of all the beauty and harmony, the stupendous movements and exquisite adaptations of our system—the entanglement of phenomena, held together by complicated laws, but mutually adjusted so as to work together to a common end—and the relation of all these things to the functions of beings possessing countless superadded powers, bound up with life and volition ? And shall we then satisfy ourselves by telling of laws of atomic action, of mechanical movements, and chymical combinations ; and dare to think that, in so doing, we have made one step towards an explanation of the workmanship of the

* This second hypothesis (though perhaps less philosophical than either of the other two) is suggested by the analogy of the repeated changes of organic species, alluded to above, each of which can be regarded only as a positive creative interference.

God of nature ? So far from ridding ourselves, by our hypothesis, of the necessity of an intelligent first cause, we give that necessity a new concentration, by making every material power, manifested since the creation of matter, to have emanated from God's bosom by a single act of omnipotent prescience.

Leaving, however, these subjects of lofty speculation, and retracing^d our steps from the first condition of created matter towards the order of things now going on before us, we see, from the form and structure of the solid masses on the surface of the earth, that many parts of it have been elaborated during successive periods of time ; and, if we cannot point out the first traces of organic life, we can find, at least, an indication of its beginning. During the revolution of countless succeeding ages, mechanical and chymical laws seem to have undergone no change ; but tribes of sentient beings were created, and lived their time upon the earth. At succeeding epochs, new tribes of beings were called into existence, not merely as the progeny of those that had appeared before them, but as new and living proofs of creative interference : and, though formed on the same plan, and bearing the same marks of wise contrivance, oftentimes as unlike those creatures which preceded them as if they had been matured in a different portion of the universe, and cast upon the earth by the collision of another planet. At length, within a few thousand years of the days in which we live (a period short, indeed, if measured by the physical monuments of time past),

man and his fellow-beings are placed upon the earth. Of the whole creation, he alone has an appetite for abstract truth—he alone sees material powers, and by the capacity of his mind grasps at them, not as accidents, but phenomena under some ruling law ; and, in describing them, he uses language (and what is language but the connected natural signs of internal thoughts ?) in which, in spite of himself, he describes the operations of intelligence and power. He turns these laws to his own account ; by his own volition works upon them, and produces consequences important to himself, and foreseen in his own mind : and thus he learns, from what he has done himself, and from the constitution of his intellectual nature, to see in all things around him contrivance and causation. All nature is but the manifestation of a supreme intelligence, and to no being but him to whom is given the faculty of reason, can this truth be known. By this faculty he becomes the lord of created beings, and finds all matter, organic and inorganic, subservient to his happiness, and working together for his good. A part of what is past he can comprehend ; something even of the future he can anticipate ; and, on whatever side he looks, he sees proofs, not of wisdom and power only, but of goodness.

But these abstract powers form not the whole immaterial part of man. He has moral powers and capacities unsatisfied with what he sees around him. He longs for a higher and more enduring intellectual fruition—a nearer approach to the God of nature : and seeing that every material organ, as well

as every vital function and capacity in things around him, is created for an end, he cannot believe that a God of power and goodness will deceive him ; and on these attributes he builds his hopes of continued being and future glory.

This is the true end to which the religion of nature points. Her light may be but dim, and beyond the point to which she leads us there may be *a way which the vulture's eye hath not seen, the lion's whelp hath not trodden, nor the fierce lion passed*—a cold and dismal region, where our eyes behold none but the appalling forms of nature's dissolution : but here our heavenly Father deserts us not ; he lights a new lamp for our feet, and places a staff in our hands, on which we may lean securely *through the valley of the shadow of death*, and reach and dwell in a land where death and darkness have heard the doom of everlasting banishment.

We should endeavour not only to mingle thoughts like these with our abstract studies, but to give them an habitual personal application—to seek, above all things, a spirit of single-mindedness and humility—to believe ourselves in the perpetual presence of God—to adore him in the glories of his creation—to see his power and wisdom in the harmony of the world—his goodness and his providence in the wonderful structure of living beings—not merely to admit these things as general truths, but to make ourselves familiar with them by frequent trains of reasoning, founded on such examples as are continually before us.

[The mere building up of knowledge is labour ill

bestowed, if not followed by improved habits of thought. But no man is passive during the acquisition of such habits. They exist only where the best powers of the mind have been steadily employed in their formation. This is a law affecting every human being. Perfection (in the limited sense in which the word can be used in speaking of the feeble powers of man) comes only by continued and well-applied labour: and the remark bears on our moral condition as well as our intellectual.

The studies of mankind have sometimes been divided into natural, moral, and religious. Each branch requires its appropriate training, and yields its own peculiar fruit. A study of the natural world teaches not the truths of revealed religion, nor do the truths of religion inform us of the inductions of physical science. Hence it is that men, whose studies are too much confined to one branch of knowledge, often learn to overrate themselves, and so become narrow-minded. Bigotry is a besetting sin of our nature. Too often it has been the attendant of religious zeal: but it is, perhaps, most bitter and unsparing when found with the irreligious. A philosopher, understanding not one atom of their spirit, will sometimes scoff at the labours of religious men; and one who calls himself religious will perhaps return a like harsh judgment, and thank God that he is not as the philosophers—forgetting all the while that man can ascend to no knowledge except by faculties given to him by his Creator's hand, and that all natural knowledge is but a reflection of the will of God. In harsh judgments such,

as these, there is not only much folly, but much sin. True wisdom consists in seeing how all the faculties of the mind, and all parts of knowledge, bear upon each other, so as to work together to a common end ; ministering at once to the happiness of man, and his Maker's glory.

Again : a man may be skilled in many branches of knowledge, and yet his affections may be wrong-placed and his bad passions unsubdued. Our conduct, in each instance in which we are called on to act, is mainly determined by the feelings and thoughts excited by the things around us. One man pursues natural knowledge, but soars not in imagination beyond material phenomena. Another sees the indications of design ; and, perhaps, goes on to mark the wise adaptation of the various parts of the material world. A third, while contemplating the world around, thinks nothing of these things ; but his imagination takes wing, and his soul is borne away in poetical emotion. A fourth feels with greater or less power what all the others feel, but adds to it a movement of thankfulness to the Giver of all good ; and this new feeling, when joined to a firm belief in the word of God, blends itself in the animating principle of Christian love. Contrasts such as these in the emotions of our inner nature, while we are under the same external conditions (and every hour's experience shows us examples of them in some form or other), arise from different habits of the soul, whether we regard them as moral, intellectual, or religious. But such habits, I repeat, have been gained only by appropriate training. If they

be intellectual, they have been gained by intellectual toil : if religious, they have come only by well-directed religious studies and religious exercises.

After every new combination, the properties of matter are essentially changed, and present a new set of phenomena. It is not, perhaps, too much to say, that, in like manner, after every new act or voluntary thought, the soul is put in a new psychological condition. Its powers of doing or forbearing are changed : for things are ever after present to it in the memory, and brought out by the associating principle in new intellectual combinations. We know the inveteracy of habits, and it is mainly through the associating principle that they gain their strength. By every fresh commission of sin, we lose both the power and the inclination to escape from the bondage of bad passion : for the storehouse of the memory becomes tenanted by images of darkness, mingling themselves with the recollections of past good, and tempting us on in the way of evil. Acts of forbearance, done on principle, give us, on the other hand, new inclinations and new capacities for virtue. The mind becomes stored with remembrance of moral victories ; the associating principle is then the source of happy recollections and good resolves ; and, above all, the soul is taught to seek for strength where it is to be found—in the fountain of all goodness. And thus a good man learns at length to do without effort, and with inward joy, what another, were he to give the whole world for the power, has no possibility of performing.

If such be the conditions of our being, and such

the relations of our thoughts to the things around us, a good training, and the commencement of good habits in early life, must be matters of inexpressible moment. This is equally true, whether, according to the bent of our minds, the question be considered in a metaphysical or a religious point of view. The remark is by no means confined to our intellectual capacities ; it applies with fuller meaning to our moral and religious sentiments—to all those feelings of the soul which call our moral powers into visible activity. A philosopher may be cold-hearted and irreligious, a moralist may be without benevolence, and a theologian may be wanting in the common charities of life. All this shows that knowledge is not enough, unless feelings and habits go along with it to give it its meaning, and to carry it into practical effect. Religion reaches the fountain-head of all these evils ; and she alone gives us an antagonist principle whereby we may effectually resist them.

In natural knowledge we may mount from phenomena to laws ; but in doing this we are held by fetters we cannot break—we cannot alter one link in the chain of natural causes—we can only mark the traces of an unvarying power, external to ourselves, and to which we are ourselves in bondage. If this be our condition in acquiring natural knowledge, what right have we to think that, in gaining religious knowledge, we are permitted to be more free?—That, in regard to our spiritual relation to God and a future state, we may indulge in any fantastical notions we think fit ; while we shut our eyes to the light that he has given us, and despise the law

that he has set before us? Madness and folly like this, in any one professing to be a Christian (and to Christians only is this discourse addressed), would be utterly incredible, did we not see it every moment before us, and did we not find all its elements lurking within our bosoms.

But, if the Bible be a rule of life and faith—a record of our moral destinies—it is not (I repeat), nor does it pretend to be, a revelation of natural science. The credibility of our religion depends on evidence internal and external. Its internal evidence is seen in the coherence of its design, from its first dawning to the fulness of its glorious light—in its purity and moral dignity—in its exalted motives, fitted to call forth man's highest moral and intellectual energies—in its suitableness to his wants and weakness—in its laying bare the inner movements of his heart—in its declarations of the reality of a future state, and of other truths most important for him to know, yet of which he has but a faint and insufficient knowledge from the light of nature. Its external evidence mingles itself in a thousand ways with the internal, but finally resolves itself into the strength of human testimony; proving that God has, at many times, made a visible manifestation of his power on earth; promulgating among mankind a rule of life, enforcing it by the terror of penal sanctions, and confirming it by miracles publicly wrought in attestation of its truth. Physical science, on the contrary, derives no support from internal evidence or external testimony; but it is based on experiment alone, is perfected by induction, and is drawn out

into propositions by rational logic of its own. To confound the groundworks of philosophy and religion is to ruin the superstructure of both : for the bases on which they stand, as well as their design, are absolutely separate ; and we may assume it as an incontrovertible truth, that the inductions of philosophy can be no more proved by the words of revelation than the doctrines of Christianity can be established by the investigations of natural science.

Should some one ask how men can overlook truths like these after they have been once enunciated, we may reply, that men have often been led into such folly by vanity and arrogance—the one shutting from their senses the narrow bounds of their own ignorance—the other teaching them to condemn what they do not comprehend. Another source of error, on physical questions, has been a mistake respecting the import of certain scripture phrases. These writings deal not in logical distinctions or rigid definitions. They were addressed to the heart and understanding, in popular forms of speech, such as men could readily comprehend. When they describe the Almighty as a being capable of jealousy, love, anger, repentance, and other like passions, they use a language accommodated to our wants and capacities, and God is put before us in the semblance of humanity. They tell, however, what it is essential for us to know—our relations and our duties to him, and the penalties of disobedience : and were it possible for them to make even an approach to the perfections of his glory, no man could, by looking on them, comprehend their mean-

ing ; and they would be at once unfitted to be the vehicle either of religious truth or moral rule. If this principle of interpretation be adopted in numberless parts of scripture describing the moral attributes of God, we may surely extend it to other passages (unconnected with any religious doctrine, and therefore of comparatively small importance), in which the fabric of the material world is the subject of some passing allusion or figurative illustration.

A philosopher may smile at the fulminations of the Vatican against those who, with Copernicus, maintained the motion of the Earth : but he ought to sigh when he finds that the heart of man is no better than it was of old, and that his arrogance and folly are still the same—that bigotry and ignorance still go hand in hand, and are ever ready to intrench themselves in any lurking-place, whence they may assail with maledictions and words of evil omen all those who are enjoying a light of truth their eyes cannot bear to look upon. There are still found some who dare to affirm that the pursuits of natural science are hostile to religion. An assertion more false in itself, and more dishonourable to true religion, has not been conceived in the mind of man. Of other sciences I am not called on to speak ; but having, in the former pages of this Discourse, described some of the general truths brought to light by geology, I may be permitted to add a few words in its vindication.

The Bible instructs us that man, and other living things, have been placed but a few years upon the earth, and the physical monuments of the world

bear witness to the same truth. If the astronomer tells us of myriads of worlds not spoken of in the sacred records, the geologist, in like manner, proves (not by arguments from analogy, but by the incontrovertible evidence of physical phenomena) that there were former conditions of our planet, separated from each other by vast intervals of time, during which man, and the other creatures of his own date, had not been called into being. Periods such as these belong not, therefore, to the moral history of our race, and come neither within the letter nor the spirit of revelation. Between the first creation of the earth and that day in which it pleased God to place man upon it, who shall dare to define the interval? On this question scripture is silent: but that silence destroys not the meaning of those physical monuments of his power that God has put before our eyes; giving us, at the same time, faculties whereby we may interpret them and comprehend their meaning.

In the present condition of our knowledge, a statement like this is surely enough to satisfy the reasonable scruples of a religious man. But let us for a moment suppose that there are some religious difficulties in the conclusions of geology. How, then, are we to solve them? Not by making a world after a pattern of our own—not by shifting and shuffling the solid strata of the earth, and then dealing them out in such a way as to play the game of an ignorant or dishonest hypothesis—not by shutting our eyes to facts, or denying the evidence of our senses, but by patient investigation, carried on

in the sincere love of truth, and by learning to reject every consequence not warranted by direct physical evidence. Pursued in this spirit, geology can neither lead to any false conclusions, nor offend against any religious truth. And this is the spirit with which many men have of late years followed this delightful science—devoting the best labours of their lives to its cultivation—turning over the successive leaves of nature's book, and interpreting her language, which they know to be a physical revelation of God's will—patiently working their way through investigations requiring much toil both of mind and body—accepting hypotheses only as a means of connecting disjointed phenomena, and rejecting them when they become unfitted for that office, so as in the end to build only upon facts and true natural causes. All this they have done and are still doing ; so that, however unfinished may be the fabric they have attempted to rear, its foundations are laid upon a rock, and cannot be shaken, except by the arm of that Being who created the heaven and the earth, who gave laws to the material world, and still ordains them to continue what they are.

But there is another class of men who pursue geology by a nearer road, and are guided by a different light. Well-intentioned they may be, but they have betrayed no small self-sufficiency, along with a shameful want of knowledge of the fundamental facts they presume to write about : hence they have dishonoured literature by *Mosaic Geology*, *Scripture Geology*, and other works of cosmog-

ony with kindred titles, wherein they have overlooked the aim and end of revelation, tortured the book of life out of its proper meaning, and wantonly contrived to bring about a collision between natural phenomena and the word of God.

The recent attacks on physical science, and the gross misapprehension of its moral tendency, have been singularly wanton and ill-timed. The living philosophers of Great Britain are a set of sober-minded men, who have betrayed no hostility to revealed truth. An exclusive devotion to one subject inevitably makes a man narrow-minded; and a successful career of intellectual toil may make a man proud and full of self, and so take from him the best graces of a Christian character. But failings like these belong to the infirmities of our nature, and are not confined to any one profession or pursuit: they may be seen in the characters of sagacious lawyers or learned divines, as well as of laborious philosophers. It would, indeed, be ridiculous to say, that all living philosophers are religious men. Like their neighbours, they have their besetting sins: but many of them are men of pure lives and firm believers in revelation; and among them may be found some who shine forth as illustrious patterns of Christian holiness.

A skeptic may, indeed, think that the whole system of things, moral and physical, has no principle of continued rest—that it has only been jostled into a condition of unstable equilibrium, which may be destroyed by the first movement of any of the component elements. Such a one may reasonably fear

the progress of discovery ; for his system wants the essential principles of cohesion. But a sincere believer in the word of God has no fear of this kind : for he knows that all the parts of the natural world are wisely fitted together—that the Lord of all nature is a being *without variableness or shadow of turning*—and that truth, of whatever kind, as seen in the mind of man, is but a perception of his Maker's will.

A man of deep thought and great practical wisdom—one whose piety and benevolence have for many years been shining before the world, and of whose sincerity no scoffer (of whatever school) will dare to start a doubt—recorded his opinion in the great assembly of the men of science, who, during the past year, were gathered from every corner of the empire, *that Christianity had everything to hope and nothing to fear from the advancement of philosophy*.* These are golden words, and full of meaning to those who have wisdom to understand them.

Another indiscretion (far different, however, from the follies I have just noticed) has been committed by some excellent Christian writers on the subject of geology. They have not denied the facts established by this science, nor have they confounded the nature of physical and moral evidence : but they have prematurely (and, therefore, without an adequate knowledge of all the facts essential to the argument) endeavoured to bring the natural history of the Earth into a literal accordance with the book of

* Speech of Dr. Chalmers at the meeting of the British Association for the Advancement of Science, June, 1833.

Genesis—first, by greatly extending the periods of time implied by the six days of creation (and whether this may be rightly done is a question only of criticism and not of philosophy)—and, secondly, by endeavouring to show that, under this new interpretation of its words, the narrative of Moses may be supposed to comprehend, and to describe in order, the successive epochs of geology. It is to be feared that truth may in this way receive a double injury; and I am certain that the argument just alluded to has been unsuccessful. The impossibility of the task was, however (as I know by my own experience), a lesson hard to learn: but it is not likely again to be attempted by any good geologist. The only way to escape from all difficulties pressing on the question of cosmogony has been already pointed out. We must consider the old strata of the earth as monuments of a date long anterior to the existence of man, and to the times contemplated in the moral records of his creation. In this view there is no collision between physical and moral truth. The Bible is left to rest on its appropriate evidences, and its interpretation is committed to the learning and good sense of the critic and the commentator: while geology is allowed to stand on its own basis, and the philosopher to follow the investigations of physical truth, wherever they may lead him, without any dread of evil consequences, and with the sure conviction that natural science, when pursued with a right spirit, will foster the reasoning powers, and teach us knowledge fitted at once to impress the imagination, to bear on the business of

life, and to give us exalted views of the universal presence and unceasing power of God.

Laws for the government of intellectual beings, and laws by which material things are held together, have not one common element to connect them. And to seek for an exposition of the phenomena of the natural world among the records of the moral destinies of mankind, would be as unwise as to look for rules of moral government among the laws of chymical combination. From the unnatural union of things so utterly incongruous, there has from time to time sprung up a deformed progeny of heretical and fantastical conclusions, by which sober philosophy has been put to open shame, and sometimes even the charities of life have been exposed to violation.

No opinion can be heretical but that which is not true. Conflicting falsehoods we can comprehend, but truths can never war against each other. I affirm, therefore, that we have nothing to fear from the results of our inquiries, provided they be followed in the laborious but secure road of honest induction. In this way we may rest assured that we shall never arrive at conclusions opposed to any truth, either physical or moral, from whatsoever source that truth may be derived : nay, rather (as in all truth there is a common essence), that new discoveries will ever lend support and illustration to things which are already known, by giving us a larger insight into the universal harmonies of nature.]

To deny all natural religion is not more strange

than to commence a system of moral philosophy by denying the existence of moral feelings. It is, I think, to deny that very constitution of our minds on which the fabric of our religious character must be built. How such a character is matured and upheld I do not now inquire : but, among persons of intellectual habits, it depends for its commencement mainly on the conduct of the mind in early life ; and, during the changes of advancing years, cannot, perhaps, be so well upheld by any ordinary means, as by a steady habit of seeing, and adoring with thankfulness of heart, the wisdom and goodness of God in the wonders and bounties of his creation. The materials for thoughts like these are placed abundantly around us.

To many minds, the forms of natural knowledge, presented in the abstractions of severe science, are cold and uninviting ; but, if we follow them with the light of other kindred studies, such as those I have endeavoured faintly to shadow out, we bring down the fire from heaven which at once gives them movement and animation.

CONCLUSION.

Having now glanced over our course of academic studies, let us endeavour shortly to give this discourse a more personal application.

There still remains untouched a subject which should be the end of all our studies. I address myself as to Christian men instructed in the record of their religion, believing in its authority, and ac-

knowledging its sanctions. Are then our lives and affections in accordance with the religion we profess and the high privileges we enjoy? Let every one put this question to himself—let him look into his innermost soul by the light of the word of God, and his own conscience will find the proper answer for him. *Though I speak with the tongues of men and of angels, and have not charity, I am become as sounding brass or a tinkling cymbal. And though I have the gift of prophecy, and understand all mysteries and all knowledge; and though I have all faith, so that I could remove mountains, and have not charity, I am nothing. . . . Charity suffereth long and is kind; charity envieth not; charity vaunteth not itself, is not puffed up, doth not behave itself unseemly, seeketh not her own, is not easily provoked, thinketh no evil; rejoiceth not in iniquity, but rejoiceth in the truth; beareth all things, believeth all things, hopeth all things, endureth all things.** If our conscience reply that such is our temper, it is well with us. But if, on the other hand, we find lurking within us a spirit of pride, of bitterness, of intolerance, of harsh judgment, of party-spirit, and of other feelings the very opposite to those described in this most touching passage of St. Paul; then, whatever be our condition and our attainments in the wisdom of the world, we are outcasts from the flock of Christ, and have no inheritance in his kingdom.

Learning, almost beyond that of man—a happy power in tracing out the proofs of natural religion—a critical knowledge of the word of God—a grasp

* 1 Cor. xiii.

of the sharpest weapons of polemical theology, may coexist in a mind manifesting hardly one single Christian grace : nay, hardly performing the most vulgar acts of moral obligation, enjoined between man and man by the sanction of the law, and without which the very framework of society could not be held together. I will not, however, dwell on any extreme case like this, but appeal once more to our own experience. We have capacities for the perception of moral truth ; we know the difference between right and wrong ; we naturally approve the one and condemn the other ; and our natural perceptions are cleared and elevated by the light of Christian truth : our duty is plainly pointed out, and enforced by the most awful sanctions. Nay, more than this, while removed from the influence of temptation, we wish to obey the word ; we wish to walk in the paths of the great and the good ; and yet we are infirm of purpose, and cannot do what our heart approves and our conscience dictates.

The sensualist surrenders his liberty to base appetite ; binding day by day fresh fetters about his limbs, till they have no power of movement. His course of life is often followed by judicial blindness ; his mind loses its upright attitude, and becomes tortuous because it finds no rest ; and he casts about his soul the mist of skepticism, to keep off that light of truth his eyes cannot endure. A religion without power over the heart is deprived of its best evidence ; and hence he learns to doubt the truth of a system of which he feels not the benefit, and to turn away from that doctrine by which his own life is con-

demned. A character like this is of no unfrequent occurrence in the ordinary commerce of life.

But I will suppose that we are sincere believers in the word of God, and not weighed down by the habitual burden of any flagrant sin. Still, if we look at ourselves, we shall find that we not only come immeasurably short of the standard set up by the Word of God, but far short of that we could ourselves set up by the natural light of conscience. Thoughts like these must pass through the mind of every reflecting Christian : and, at times, while toiling in his earthly vocation, or even when striving after what he thinks his duty, he will be weighed down with a feeling of self-abasement, and be ready to cry out with St. Paul, *Oh wretched man that I am, who shall deliver me from this body of death?* Religion gives an answer to this question. We have the power of discerning good and evil ; this coexists with our natural condition ; but the power of acting steadily and undeviatingly on the dictates of conscience is not given us by nature ; and here religion steps in and points out the only remedy for this discordance and confusion in the moral world.

If we be not the basest hypocrites in our religion ; if we do not utter a mere idle form of words, opposed both to the conviction of our reason and the approval of our conscience, then must we believe that there is a superintending Providence who governs the world. To this doctrine we can make an approach, even by the feeble light of natural religion. We must farther believe, that for the moral ruin and confusion we see around us, God has provided a

special remedy by the sacrifice of his Son, who now sits exalted at his right hand, as our mediator and spiritual head. And, lastly, we must believe, that by a communion with this our head (sustained by all the ordinances of religion—by public and by secret prayer), we obtain at once the benefit of this sacrifice, and the covenanted promise of a new principle of life, and a new power of moral obedience. It is by winding itself into our affections—by reanimating the principle of love—that religion has this power. In expelling from the heart its corrupt affections, it leaves it not an open prey to still baser appetites, but fills it with its first and noblest occupants, and thus restores the moral man to his Maker's image and his Maker's favour. It is thus that the religion of Christ does not oppose, but lends support to all those high faculties that give its only true elevation to the character of man; in proof of which (were there any doubt of what I am stating), we need only cast our eyes over Christendom, and contrast its glories with the intellectual darkness of every land whereon the light of the Gospel hath not yet shone.

Finally, to bring this home to ourselves, we are no true children of our Lord and Master—we are no part of his flock, if we honour him not by the outward forms of allegiance he has himself enjoined; if we seek him not by the way he has himself appointed—by acts of public devotion—by the earnest petitions of private prayer, lifted up to Him, not only as the giver of all good, but as the giver of that power by which alone we can root out our corrupt affec-

tions, and bring into full life the better principles of our nature. Let, then, prayer be the beginning and the end of our studies ; and so they will be consecrated to God.

ON THE
IMPORTANCE
OF
SCIENTIFIC KNOWLEDGE
TO THE
MANUFACTURER AND PRACTICAL
MECHANIC.

BY GULIAN C. VERPLANCK.

ON THE
IMPORTANCE OF SCIENTIFIC KNOWLEDGE
TO THE
MANUFACTURER AND PRACTICAL MECHANIC.*

SEVERAL years ago, in conversing with a very ingenious and well-informed friend now deceased, I was much struck by a transient observation of his. "In spite," said he, "of man's boasted intellect, he is as much indebted for his present state in civilized life to the hand as to the head. Suppose," proceeded he, "that the human arm had terminated in a hoof or a claw instead of a hand, what would have been the present state of society, and how far would mere intellect have carried us?"

I do not know whether this idea was original with my friend or not, although I have never since heard it or met with it in books; and, as he did not follow it out any farther, I cannot say what were the particular consequences he meant to infer from it. Let us for a moment take up the supposition and follow it out for ourselves. Let us suppose that all the other original, as well as secondary causes, which

* The following discourse was delivered before the Mechanics' Institute of the City of New-York, November 27th, 1833.

have operated upon the human race to bring civilized society to its present state of art, power, knowledge, refinement, and wide-spread comfort and luxury, to have remained as nearly as possible the same. Let us imagine the reason of man to have been as powerful, his curiosity as active, his talent, courage, energy, enterprise, equal, nay, if you will, superior to that which he now possesses and exerts. But, in place of his hand, that exquisite and wonderful piece of mechanism, so beautiful in its contrivance, so perfect in its construction, so infinite in its uses, obeying the mind's impulse with an accuracy and rapidity which the mind itself cannot comprehend or follow—in place of that hand he has the paw of a wild beast. Under such circumstances, unquestionably, some form of society, of government, and of social order might exist. The human mind might slowly observe and compare many of the truths of reason and the laws of nature. The first principles of mathematics, depending, as they do, upon pure reason, might possibly have been discovered, and the science of numbers, and figure, and measure developed in theory by individuals, to no inconsiderable extent. In a race of men so formed, there might possibly be poets and orators, whose fancy or eloquence might have rivalled or resembled those of the great names of the world's early history. There might, and there doubtless would, have been the frequent exertion of brute valour; and there probably would have been sometimes added that application of mind to courage, which makes of the soldier a hero, a leader, a conqueror.

But here the force of mere mind in such a world as ours must have stopped. Without the mechanical assistance of the hand, most of the discoveries and improvements of each generation must have died with them, and left no preparatory stock of knowledge to the next, for the want of the art of writing. But this, however great it may seem in itself, is but the most inconsiderable of the privations to which man would be subject. "Man," said Franklin, "is a tool-making animal," and without the hand where would be the tools of agriculture—the plough, the spade, and the wagon? where the builder's skill and the houses which now shelter happy families, in place of the cave and the forest? where the boat, the sail, the ship, which connect nations together, and make the wealth and the wisdom of each portion of our race in some degree the property of all. As we proceed in this analysis, we may thus trace back the comfort, the happiness, the safety, the splendour, nay, the very virtues of social and civilized life to the industry of the hand. Still all this is the fruit of the labour of the hand guided by intelligence. It is the toil of the hand directed by experience, strengthened by knowledge gained by past experiment, by the observation of nature, and by the application of reason to that experience and observation. This it is that constitutes that enlightened labour to which society owes its elevation and its happiness. This it was that

"Roused man from his miserable sloth,
His faculties unfolded, pointed out
Where lavish Nature the directing hand
Of Art demanded, showed him how to raise

His feeble force by the mechanic powers,
To dig the mineral from the vaulted earth,
On what to turn the piercing rage of fire,
On what the torrent and the gathered blast,
Gave the tall ancient forest to his axe,
Taught him to chip the wood and hew the stone,
Till by degrees the finished fabric rose ;
Tore from his limbs the blood-polluted fur,
And wrapped him in the woolly vestments warm ;
Nor stopped at barren, bare necessity,
But, still advancing bolder, led him on
To pomp, to pleasure, elegance and grace,
And breathing high ambition in his soul,
Let science, wisdom, glory in his view,
And bade him be the lord of all below.”*

Such, in the language, but without any of the exaggeration of poetry, are the magnificent results of intelligent industry, of the hand executing what the mind has devised or discovered ; either of them without the other being powerless to any greatly useful end. The mind without the hand must be compelled to waste its force upon barren speculation, or to amuse itself with the fleeting visions of fancy. The hand without the guiding mind is bloody and dangerous, quick to injury, slow and awkward in any work of peace. Let them act together in intelligent unison, and then the whole man and the whole frame of society will move together, in cheerful activity, right onward to their highest possible perfection and happiness. It is the boast of our own country, and times, and civil condition, that they are all auspicious to this union and the attainment of these ends. To co-operate to the best of his ability in securing and hastening forward this excellent and beneficent effect, and especially to make its blessings more im-

* Thomson.

mediately felt by those around and about him, is at once the duty of every good citizen, and his most exalted privilege.

It is with such motives and views that you, fellow-citizens, have founded the MECHANICS' INSTITUTE OF THE CITY OF NEW-YORK. Its primary object you have stated, in your constitution, to be "the instruction of mechanics and others in popular and useful science, by means of lectures, apparatus, models of machinery, a museum and library."

In discharging the grateful and honourable duty which you have confided to me, of opening the course of scientific lectures arranged for the present season, perhaps I cannot better employ the limits of an introductory lecture, too circumscribed for the particular elucidation of any single prominent branch of scientific inquiry, than by considering a few of the more important advantages which may justly be expected to flow from instruction of the kind proposed by your institution.

Let me invite your attention, first, to the consideration of the probable beneficial effect of the diffusion of scientific knowledge, among those practically and habitually employed in the mechanic and manufacturing arts, as it is likely to operate upon the improvement and advancement of the arts and sciences themselves. This is a view of the subject which probably did not occupy the foreground in the minds of the founders of the Institute; but I place it first, because it first occurred to my own thoughts, and because too, if not the very first in importance among the many uses of such institutions as this, it is scarcely secondary to any other.

Perhaps there is no better définition of science than that it is knowledge acquired by the thoughts and the experience of many, and so methodically arranged as to be comprehended by any one. That which exhibits the truth, reasoned out by the mind from its own intuitive perceptions, and which relates not merely to that which is, but to that which *must* be (such as the deductions of mathematics), constitutes abstract science.

Physical science is the methodized and, therefore, simplified knowledge of the order of nature, so far as hitherto observed. This consists mainly in the classification, under general rules and names, of multitudes of observations and experiments. It arranges and generalizes the observations of all ages made by those who, with eager eyes and attentive minds, have read the great book of nature, which she opens of her own accord to all men; and the experiments that by new and bold combinations of agents, or powers that do not ordinarily appear together, have questioned Nature herself, and forced her to reveal the secret rules and methods of her mighty operations. It is the business of the true teacher of useful science to lay all this before his pupils clearly, briefly, and methodically, thus following out and applying that beautiful and benevolent fundamental law of the Author of all being and of all wisdom, who, governing all things by vast and comprehensive rules, includes millions of apparently jarring phenomena under the operation of some single cause, and has thus made a kind provision whereby the limited mind of man may grasp and turn to its own uses the laws that sway the whole creation.

The theory of science, then, is the exposition of known facts, arranged in classes and expressed in words. Let, then, this general and preparatory acquaintance with the ascertained laws of nature be widely spread among those who are constantly and habitually engaged in the various operations of the useful arts, and what will be the probable consequence? Instead of a comparatively few observers, most of whom see nature "through the spectacles of books," or, at best, on the limited scale of the laboratory or the lecture-room, we have at once hundreds of men well-grounded in the principles of chemistry, mechanics, and general physical science, perpetually observing, watching, comparing, applying the working of those principles on the largest scale, and under some peculiar advantages, which the man of mere speculative science can rarely enjoy. For instance, all who have ever turned their attention to mechanical invention, know how often and how signally the most ingenious conceptions, succeeding admirably in the model, are frustrated and found worthless when applied to practice on the scale necessary for any useful purpose. However valuable the model may be as an auxiliary, nothing but actual experience can teach the operation of friction, of gravity, of the nature of materials, of the varying proportion of weight and strength in relation to an increased scale of size, and numerous other circumstances, which it would require a lecture to detail.* But the knowledge of all this is precisely

* See them well explained in an ingenious paper by Mr. Sang, "On the relation between a Machine and its Model," printed in *Silliman's Journal*, vol. xxii., No. 2.

what constitutes the difference between the accomplished speculative projector and the successful practical machinist ; and as all this is every hour before the eyes of the actual mechanic, it surely must prove a great thing for the improvement of mechanical skill and invention, to have this observation assisted and enlightened by sound theory, or, in other words, by a clear and distinct apprehension of what has already been invented or discovered.

In visiting our national Patent Office and conversing with the officers of the establishment, it becomes a common subject of remark, how prodigious a waste of ingenuity, in various ways, and particularly in mechanical contrivance, takes place annually in this country, from the want of a more general knowledge of the actual state of improvement in the several departments of invention. Hundreds of useful or ingenious machines have been thus reinvented, doubtless with no little loss of that intellectual labour which, if it had been applied in improving or building upon what was already known, might have opened to society new sources of comfort, of pleasure, or of power.

The advantages of experience and observation on a large scale are by no means peculiar to mechanical ingenuity. Indeed, I meant to draw from it simply an example or illustration of a truth common to all the mechanic and manufacturing arts. It is peculiarly true with regard to the chymistry of the arts. It has been remarked by the most successful chymists of our day, that some of the most important manifestations of the laws of chymical action

could hardly have been discovered in the course of any of the experiments of the chymical laboratory, however skilful or costly. In order to manifest themselves to observation, they require the action of large masses or quantities together, perhaps that of the elements upon them, or of a considerable lapse of time. In fact, the very foundation of modern chymistry, or, at least, of that branch of it termed pneumatic chymistry, was laid in a brewery. There had been no lack of ingenuity, no sparing of labour or expense, no flagging of zeal or curiosity among the old chymists. But the larger and more striking field of observation and combination afforded to Dr. Priestley by the vats and gases of his neighbour the brewer, opened a new world to inquiry. From the thick vapours of the brewhouse, like one of the gigantic genii of Oriental romance, arose that mighty science which has given to enlightened art a more than magical sway, enabling her to clothe her productions with vivid beauty, to dispense among all those fabrics which were once reserved for kings and princes, to chase away disease, and to arm man with a strength such as ancient poets never dreamed of in their wildest tales of heroes, giants, and demi-gods.

Will it not, then, promise much for the still farther and more rapid advancement of knowledge and art, if all those immense processes, combinations, unions, affinities, conversions, formations, decompositions, which are incessantly going on in the brewery, the dyehouse, the distillery, the manufactory of drugs, paints, metals—in short, in all the establish-

ments of refined and ingenious art—I say, to have all these watched, noted, tested, analyzed, applied, separated from whatever may impede their action, or united to whatever may add to it—and this done by men skilled in their particular vocations, and, moreover, able to call in the aid of science to explain difficulties or direct observation ?

It is wonderful how the elements of the most precious knowledge are spread around us ; how to the curious and instructed observer everything is full and rich with the means of benefiting the human race. The slightest accession to our knowledge of nature, or our command over it, is sure ultimately to connect itself with some other truth, or to unfold its own powers or relations, and thus to lead on to some practical benefit, which the boldest conjecture could never have anticipated. The ignorant and the idle suffer all such opportunities to pass by them as the vagrant breeze. But such will surely not be the case with industrious men, prepared by general science (as it is the object of this institution to prepare them) to turn those occasions to the best account. In so saying, I do not speak from hope, or conjecture, or theory, or the desire of stimulating your zeal by flattering words. I argue from experience. I draw my anticipation of what may be from the actual history of what has been. Let me give you the evidence of this by some few examples selected out of many hundreds. Take, for instance, the history of one of the most recent and precious gifts which chymistry has made to medicine.

A few years ago a soap manufacturer of Paris,

M. Courtois, remarked that the residuum of his lye, when exhausted of the alkali, produced a corrosion of his copper boilers, which struck him as deserving special inquiry. "He put it," says Mr. Herschel, "into the hands of a scientific chymist for analysis, and the result was the discovery of one of the most singular and important chymical elements, *iodine*. The properties of this, being studied, were found to occur most appositely in illustration and support of a variety of new, curious, and instructive views then gaining ground in chymistry, and thus exercised a marked influence over the whole body of that science. Curiosity was excited; the origin of the new substance was traced to the sea-plants, from whose ashes the principal ingredient of soap is obtained, and ultimately to the sea-water itself. It was thence hunted through nature, discovered in salt-mines and springs, and pursued into all bodies which have a marine origin; among the rest, into sponge. A medical practitioner (Dr. Coindet, a Swiss physician) then called to mind a reputed remedy for the cure of one of the most grievous and unsightly disorders to which the human species is subject—the *goître*—which infests the inhabitants of mountainous districts to an extent which, in this favoured land, we have happily no experience of, and which was said to have been originally cured by the ashes of burned sponge. Led by this indication, he tried the effect of iodine on that complaint, and the result established the extraordinary fact, that this substance, taken as a medicine, acts with the utmost promptitude and energy on *goître*, dissipating the

largest and most inveterate in a short time, and acting (of course with occasional failures, like all other medicines) as a specific or natural antagonist against that odious deformity."

Now consider what a mass of human misery, for a long series of generations to come, has been relieved or removed by this discovery, arising from the single circumstance of a Parisian soap manufacturer being an observing man, who understood the uses and nature of chymical analysis. How many human beings, who would have dragged out a wretched existence, deformed, dejected, and miserable, may now lead healthy and happy lives, in consequence of a discovery depending upon a circumstance which would probably never have fallen under the notice of the learned physician or the mere chymist of the laboratory.

Let us cross the channel to Great Britain for some farther examples, and learn from what has been done there by mechanical, united to scientific skill, what we may reasonably hope to see done among ourselves.

It were idle to waste words in showing how much of the present prosperity, wealth, intelligence, and means of enjoyment in the civilized world, depends upon the art of navigation, and how much the perfection of that art is connected with the accuracy and advance of astronomy; and, again, how that science depends upon the excellence of its great instrument, the telescope. The telescope, in its earlier stages of invention, had received all the improvement that could then be furnished by the ge-

nus of the great Galileo, the father of modern science, and by the superhuman philosophical sagacity of Sir Isaac Newton, as well as of their disciples and followers, the most learned and ingenious men of Europe, such as the English Hooke, the Dutch Huygens, and the German Euler.

The product of these labours was indeed an admirable proof of the power of human invention; yet it was accompanied with imperfections, especially in the refracting telescope, that seemed insuperable. Your lecturer, when explaining the doctrines of optics, will state to you, more fully and clearly than can now be done, the nature and cause of this difficulty. It is sufficient for my present purpose to say, that from the supposed inherent imperfection of the refractive powers of glass, the images seen by the aid of telescopes were formed very indistinct and confused, being tinged strongly with the several prismatic colours. The removal of this defect was reserved for JOHN DOLLOND, originally a silk-weaver, and afterward an optician and instrument maker, of London. Half a century after Newton's experiments, Dollond conceived the idea that the refractive powers of different kinds of glass might be made to correct each other. In this he completely succeeded, and by the combination of scientific sagacity with that tact which is the growth of experience alone, at once enriched theoretical philosophy by the discovery of an important optical law, and in his achromatic telescope presented a more perfect and commodious instrument to astronomy. Had he not been familiar with the science of Newton,

Dollond would never have attempted this discovery ; had he not also been a practical mechanic, it is hardly probable that he would have succeeded.

The incidental mention of the ultimate advantages derived by the art of navigation from the labours of Dollond, suggests to my mind another illustration, and recalls the name of JOHN SMEATON. He was by regular trade a philosophical instrument maker, but his active mind had taken a broad range of rational curiosity and employment, embracing almost everything in science or art that could throw light on mechanical contrivance. His inventions of this sort were very numerous and ingenious, but his solid fame rests chiefly upon the erection of the Eddystone Lighthouse. Its site was one of the utmost consequence to the naval and commercial marine of Great Britain, and, indeed, of the world. As it was to be placed on a reef of rocks, far from the main land, and exposed to the whole force of the waves of the Atlantic, the building of a durable edifice there had baffled the skill of the ablest architects. At that period, about the middle of the last century, that branch of marine construction which relates to piers, moles, artificial harbours, breakwaters, &c., was far from that scientific development it has since received, and which it in no small degree owes to Smeaton himself. The commissioners for rebuilding the lighthouse, aware of the difficulties they had to encounter, reported that this was not an undertaking for a mere architect, however skilful, but required the talent of some one eminent for general mechanical skill and contri-

vance. Smeaton was selected. His plan was wholly original, having been suggested immediately by the consideration of the means used by nature to give durability to her works, and taking the model of strength and resistance to the elements which she had given in the trunk of the oak.* The execution corresponded with the boldness and perfection of the first conception. There are few narratives of more intense interest or varied instruction than his own account of this great work, which is among my earliest and most vivid recollections of this sort of reading. I will not attempt to mar it by a meager abstract. It is enough to say that this noble effort of mechanical genius, thus grafted upon and made part of the rocky bottom of the sea, and resisting the immense might of the ocean, which it faces, has never been surpassed or improved upon, but has been the model or guide of numerous subsequent works of marine construction of great excellence and unbounded utility.

The ancient Pharaohs of Egypt, in the pride of conquest or the vain hope of immortality, exhausted the labours of millions of slaves to rear immense py-

* "The building," says one of Smeaton's biographers, "is modelled on the trunk of an oak, which spreads out in a sweeping curve near the roots, so as to give breadth and strength to its base, diminishes as it rises, and then again swells out as it approaches to the bushy head, to give room for the strong insertion of the principal boughs. These boughs are represented by a broad, curved, solid stone cornice, the effect of which is to throw off the heavy seas, which, when thus suddenly checked, fly up, as is said by eye-witnesses, fifty or a hundred feet above the top of the building, and are thus prevented striking and injuring the lantern containing the lights, though for the moment enclosing it all around."

amids and tall and huge granite obelisks. The imperial Trajan, the most illustrious name of Rome after the loss of her liberties, decorated his forum with that magnificent column which still bears his own name, and upon which the sculptor lavished his art, to commemorate the victories of its founder over the Dacian barbarians, as they were called ; that is to say, over a race of free and brave men, who had struggled for their liberties against the grasping tyranny of Rome, with a courage and talent worthy of a better fate. Napoleon, whose sublime genius and grand aspirations were yet unhappily alloyed by so great an admixture of the meaner ambition of ordinary kings and conquerors, reared, in his own capital, the lofty brazen column of his victories, cast from artillery won on the bloody fields of Marengo, and Jena, and Austerlitz. Upon that vast bronze, the veteran companions of his glories can behold, in bold relief, the storied images of their campaigns, their toils and their exploits, and those of their chief and their hero.

But in the eye of sober reason, how poor and how vain are these monuments of pride, of power, of glory, and even of genius, when compared to the solitary, sea-girt, unadorned Atlantic tower, which perpetuates the name, the talent, and the unambitious labours of John Smeaton ! The glories of the conquerors have vanished like the morning mist. Their conquests and their empires have crumbled into dust ; but the Eddystone tower stands firm amid the tempest and the uproar of the ocean ; and there, and wherever else its form is imitated and its principles

applied, as on our own coasts and on the shores of our western lakes, it throws its broad light across the storm and the gloom, giving safety to the mariner, and guiding that commerce which, making the natural riches of every climate the common property of all, is surely destined to bind together the whole family of man in the mutual and willing interchange of art, and learning, and science, and morals, and freedom.

I might continue my illustrations from the history of useful science to an extent far beyond the limits that would be proper on this occasion. The names and lives of our own distinguished benefactors of mankind—Franklin, and Rittenhouse, and Whitney, and Fulton, and Perkins—press upon my memory. Again, the history of the watch and clock, from their early invention to their present admirable state of perfection in the astronomical clock and the marine chronometer, as successively improved by men educated in the practical art and able to apply the helps of science, would alone afford the materials for a lecture.

The history of printing offers another tempting field of collateral illustration. I might show you how numerous and how precious are the contributions that have been made by a succession of learned printers to literature, philosophy, and those principles of tolerance and freedom which it is the sacred office of the press to perpetuate and diffuse. I might tell of the Italian Aldus and his sons, of Henry Stephens of Paris and his learned family, of the Dutch Elzevirs, the English Bowyer, the Scotch

Foulis and Duncan, and surely could not forget the noblest name of them all, our own Franklin. It is from the influence of these men, and such as these, that the printing office has become, to use one of its own phrases, the *Chapel* of Liberty, where is her living presence, and where are reared the altars upon which are daily kindled the clear and bright lights of instruction for the illumination of mankind? There the goddess treasures up her arms, her ægis, and her lightnings. There is she worshipped by an assiduous, an intelligent, an ardent, and a faithful priesthood.

I must also reluctantly refrain from detailing the studies, inventions, and improvements of the potter, JOSIAH WEDGWOOD. His chymical and geological acquirements, applied to the experience of his Staffordshire pottery, have filled the houses of all classes with those cheap, cleanly, and elegant luxuries of china and finer earthenware, such as before his day princes alone could purchase; while his pure taste and acquaintance with antiquity have imparted to the ordinary productions of the potter's mould and lathe the grace and beauty of the most costly works of ancient art.

I content myself with barely indicating these points of illustration, leaving them to be followed out by your own reading or recollection. But from among the names which thus crowd upon me, let me adduce one more bright example, which I chiefly select, because it is most intimately and gloriously connected with that application of science to which our own country, and, I may add, our own state and city, are most largely and peculiarly indebted.

It was about this season of the year, just seventy years ago, that the instrument maker employed by the University of Glasgow received from the professor of natural philosophy in that ancient seminary of learning a broken model of the steam-engine as then used, to be put in order for his lectures. It was the simple and very imperfect machine of Newcomen, the best form of the steam-engine that had then appeared, and which had been found rather useful as a somewhat economical substitute for the labour of men or horses. But no one had yet viewed the steam-engine as the means of a new creation of force, whereby the winds and the waves could be breasted and subdued, the weight of mountains raised, or the most delicate manipulations of the human hand imitated and surpassed. An ordinary workman, after admiring the ingenuity of this imperfect machine, would have made the necessary repairs, sent it back to the lecture-room, and the world would have gone on as usual. But it had fallen into the hands of JAMES WATT, a young mechanic of singular and various inventive sagacity, and of most patient and persevering ingenuity, who, in addition to much miscellaneous information and some mathematical acquirement, had been led by a liberal curiosity to master all that was then known of chymistry and theoretical natural philosophy in its broadest sense. He was struck with the latent capabilities of the agent used in the imperfect engine before him; and, to develop these powers, he applied his mind, he tasked his invention, he called in the aid of all collateral science. The mode and extent of

his success have doubtless been heretofore explained to those of you not practically acquainted with the subject, and will, I presume, again form a part of this winter's course of instruction. I invite you now only to consider what was achieved by the labours of Watt. He was not merely the improver of the steam-engine, but, in fact, as to all that is admirable in its structure or vast in its utility, he has the clear right of being honoured as its inventor. "It was by his invention," says an eloquent eulogist of his character and genius, "that its action was so regulated as to make it capable of being applied to the finest and most delicate manufactures, and its power so increased as to set weight and solidity at defiance. By his admirable contrivances, it has become a thing stupendous alike for its force and its flexibility; for the prodigious power that it can exert, and the ease, precision, and ductility with which it can be varied, distributed, and applied. The trunk of an elephant, which can pick up a pin or rend an oak, is as nothing to it. It can engrave a seal, or crush masses of obdurate metal like wax before it—draw out without breaking a thread as fine as a gossamer, and lift a ship of the line like a bawble into the air. It can embroider muslin and forge anchors—cut steel into ribands and impel loaded vessels against the winds and waves."

But look around for yourselves—on our rivers and lakes—on the manufactures of Europe and America, piled up in our shops—on the railroads which traverse, or are just about to traverse, our Continent—on the wealth, the power, the rapid in-

terchange of commerce and intelligence produced by the modern steam-engine, and then let me remind you that all this is the fruit of the solitary labours and studies of a Glasgow workshop, directed by an active, vigorous, daring, but most patient and persevering mind, which knew how to use well the knowledge that other wise or ingenious men had previously reasoned out or discovered. Much of this stupendous result Watt beheld with his own eyes, for he continued to apply and improve his invention for more than half a century. He lived to see the complete success of its application to navigation by our own Fulton, who, great as were his various merits and inventive resources, would have laboured in vain had he been obliged to rely for the moving power of his machinery upon the feeble ancient engines of Savary or Newcomen. Watt died in 1819, full of years and honours.* How splendid a reward of well-directed intellectual labour! What an animating excitement is the contemplation of it to the best aspirations of a bold and generous, but also of a wise, a useful, and a benevolent ambition!

I trust that I need adduce no farther evidence to

* Among these honours must be particularly noticed two sketches of his character: the one from the pen of Francis Jeffrey, the other from that of Walter Scott. In both of these, those eminent men have done honour to themselves as well as to the memory of their friend, by the warmth of feeling with which they have described his virtues and talents, his amazing stores of miscellaneous knowledge, and that unclouded, amiable temper and unflagging benevolence which made this profound philosopher, this creator of power, this potent magician, whose machinery has changed the whole world, to be in private life one of the most delightful companions, and the best and kindest of human beings.

show of what infinite consequence it is to society, that the phenomena and the processes of nature and art should be constantly watched by well-instructed eyes, and of what incalculable value the slightest new fact thus gathered (as in the case of the chymical antidote to the disease of goître) may prove to the whole human family. Thus it is, that whether, like Dollond, Smeaton, or Watt, you are yourselves the happy agents of spreading more widely the dominion of mind over matter, or whether you merely enrich human knowledge by some single additional fact, the use of which may at some future time be developed by others, you will in either case attain the generous wish so well and strongly expressed in the plain but expressive words of one of the reports of your Institute, and "will leave the world in a better state than you found it."

There is, I think, another and not less wholesome influence upon science, to be derived from its being made familiar to the thoughts of men, whose ordinary habits of life are exclusively practical.

It would be a poor affectation in me were I to pretend to hold cheap the acquirements of the closet, and the researches and conclusions of retired and speculative philosophy. For in this class must be reckoned the wisdom of Newton, Leibnitz, Euler, Locke, Butler, the great lights of mathematical, and physical, and moral truth. But it must be confessed, that it is the uniform tendency of all purely speculative and scholastic science to wander into visionary abstractions, to shroud itself in abstruse technicalities, and, above all, to substitute words of learned

length, and rules or maxims of arbitrary authority, to simple and intelligible reason. Thus men of erudition and science often impose upon themselves as well as upon others. Now I can imagine no more effectual corrective to this tendency than the bringing science to the test and the ordeal of the general mind, the applying to its doctrines the reason and the experience of society. Not that every man, or any one man, can be capable of judging the soundness or worth of all science ; but that the aggregate good sense of the community is thus brought to bear upon the whole body of theory. Mysteries enough in physical and moral nature will still remain ; but they will be known and confessed to be so from the present limited powers of the human mind. We shall not think we understand them, because we have good and well-sounding words wherewith to conceal our ignorance. Two centuries ago all the wonders of nature were explained, or supposed to be so, by the mystical and imposing maxim that "Nature abhors a vacuum." Then came a theory of *vortices*, or little and great whirlpools pervading all creation, and these, too, accounted for everything. We should have never found out that all this was a string of empty words and arbitrary assertion, if men had done nothing but write or talk on the subject. It was the air-pump and the barometer, the crucible and the retort, the application of science to the wants of life, that silently refuted it all and substituted more solid knowledge. An excellent writer of our own day (Mr. Herschel), to whom I have been before indebted, has so well and

strongly stated the truth which I wish to impress, that I should only dilute his sound and manly sense were I to clothe his ideas in any other words than his own.

“Knowledge can neither be adequately cultivated nor adequately enjoyed by a few. It is not, like food, destroyed by use, but rather augmented and perfected. It acquires, perhaps, not a greater certainty, but, at least, a confirmed authority and a probable duration by universal assent ; and there is no body of knowledge so complete but that it may acquire accession, or so free from error but that it may receive correction by passing through many minds. Those who admire and love knowledge for its own sake, ought to wish to see it made accessible to all, were it only that its elements may be the more thoroughly examined into, and more effectually developed in their consequences, and receive that ductility and plastic quality which the pressure of minds of all descriptions, constantly moulding them to their own purposes, can alone bestow. To this end it is necessary that science should be divested, as far as possible, of artificial difficulties, and stripped of all such technicalities as tend to place it in the light of a craft or a mystery, inaccessible without a kind of apprenticeship. Science, of course, like everything else, has its own peculiar terms ; and these it would be unwise, were it even possible, to relinquish ; but everything that tends to clothe it with a strange and repulsive garb, and especially everything that, to keep up an appearance of superiority in its professors over the rest of mankind, assumes an unne-

cessary garb of profundity and obscurity, should be sacrificed without mercy. Not to do this is to deliberately reject the light which the natural, unencumbered good sense of mankind is capable of throwing on every subject, even in the elucidation of principles. But where principles are to be applied to practical uses, it becomes absolutely necessary ; as all men have then an interest in their being so familiarly understood that no mistakes need arise in their application.”*

We may remark something analogous to this effect in our personal experience of the operations of our minds. A man may have worked out in his head a new general rule in arithmetic, or he may plan a large building, or scheme out in his mind a machine in all its parts to his perfect satisfaction. Yet he cannot safely rely upon these mental abstractions until he reduces them to an actual trial ; of the rule, for instance, by working a question or problem with it ; of the plan by laying it down on paper ; or of the machine by essaying it in a model ; in short, as the phrase is, he must see how it works. Then there is always an even chance that he will find that his general ideas were, if not somewhat erroneous, at least inaccurate ; that he had overlooked or omitted something essential. But the putting the great body of men of experimental skill in possession of the principles of scientific theory, is precisely the doing, on a very extensive scale, what the individual does on a small one, in such cases as those

* Discourse on the Study of Natural Philosophy, by I. F. W. Herschel.

just mentioned. This will show how the theory works. This tries and proves, or else limits and corrects, the general propositions of speculation, by comparing them with specific examples, and thus submitting them to the experience and common sense of mankind.

This salutary influence of general inquiry and knowledge is by no means limited to pure science. We may go much farther. Mathematicians have said, and truly, that the spirit of geometrical reasoning is not limited in its application to mere geometry ; but that the method, the clearness, the exactness that distinguish mathematics, gradually communicate themselves to other studies, opinions, and pursuits, so that, at length, their effect is felt even among those who are ignorant of mathematics. Such, it seems to me, must be the effect of sound and well-digested knowledge of any kind upon the general habits of the mind, and ultimately upon all the great interests of society. It forms and strengthens a rectifying and methodizing power of the understanding, such as that for which James Watt and Benjamin Franklin were so eminently distinguished upon every subject that came under their examination. It induces the regular appetite for distinct reason, the desire of light and truth in all things. Now error and fraud love to hide themselves in a cloud of wordy generalities—to intimate mysterious difficulties—to magnify the importance of phrases, or terms, or usages, of ambiguous or of no meaning, though sanctioned by time, or by party, or by authority—in short, to protect themselves and impose

upon others by means which, when at length honestly analyzed, turn out to be mere *humbug*. The word is a coarse one, and is branded by critics and dictionary-makers as low. I believe it may be so. I can only wish that the thing itself received no more countenance among the great and learned than the word.

But real wisdom and legitimate science, however abstruse or difficult upon the first examination, whatever great and unsurmountable mysteries may be mixed with their certainty, yet dread not the public gaze. They ask no aid from delusion or from ignorance. They claim the light of day, and rejoice and expand themselves in the full flood of its noon-tide blaze.

Therefore it is, fellow-citizens, that the diffusion of real knowledge, and the universal habit of investigating scientific or moral truth, cannot but ultimately have a most purifying and exalting effect upon our political institutions, our jurisprudence and administration of justice, our civil and even municipal and local policy.

It is sufficient to have indicated these general views: you will yourselves judge of their correctness. I could not enlarge upon them without at least entering upon topics leading to controversial discussion.

I have not yet touched upon the influence of knowledge, such as that to which your institution invites the mechanics of this city, upon the operative and producing classes themselves, in improving the character, raising the thoughts, awakening sleeping

talent, and thus qualifying this great and valuable body for the able, just, right, wise, and honourable discharge of all the duties of men, of citizens, of freemen, and of patriots. This is alone and in itself a theme full of interest—full of excitement. As it was doubtless a leading motive in founding this Institution, I had intended to make it the principal subject of this opening lecture. But I found that it was so familiar to the thoughts—I may rather say to the hearts—of your members, and it had already been so strongly and well-urged in the addresses and reports of your committees, that I could add very little indeed to the deep conviction and impression that had already been made. This gives the promise of a noble harvest of usefulness from the seed which may be sown here. But it was for these reasons that I have rather chosen to attempt exciting your minds to the holy ambition of “leaving the world better than you found it,” by pointing out what experience has proved that you can do for the cause of science and reason, than to repeat what you already know and feel, and to tell you what science and reason can do for you.

Yet if exhortation on this head were needed, you would find in the history of our own country a lesson to this effect, far more instructive, far more animating, far more impressive, than any that mere rhetoric, such as mine, could give—than even the highest cloquence could teach. What is the history of our war of Independence but the story of the struggles of a poor and a peaceful, but a generally educated, well-informed people, against cultivated

talent, abundant wealth, and disciplined valour?
Then, in the glowing language of one of our own
bards,*

“Then war became the peasant’s joy; her drum
His merriest music, and her field of death
His couch of happy dreams
After life’s harvest home.

He battles, heart and arm, his own blue sky
Above him, and his own green land around;
Land of his father’s grave,
His blessing and his prayers!

Land, where he learned to lisp a mother’s name,
The first beloved on earth, the last forgot—
Land of his frolic youth—
Land of his bridal eve!

Land of his children! Vain your columned strength,
Invaders! vain your battle’s steel and fire!
Choose ye the morrow’s doom,
A prison or a grave.”

Such were Saratoga’s victors—such the brave
men whose blood earned our liberties. Foremost
among these was the blacksmith of Rhode Island,
NATHANIEL GREENE; he whom Hamilton, while
he honoured Washington as “the first *man* of the
country,” did not hesitate to style “the first soldier
of the Revolution.”† He was a man not more re-
markable for his genius and patriotism, than for his
insatiable thirst for knowledge, and the eagerness
with which, even in early youth, he seized upon every

* Halleck. Field of the Grounded Arms.

† I state this opinion and language of General Hamilton, in
relation to the military character of Greene, on the authority of
the late Colonel Marinus Willet (who cordially concurred in the
same opinion), as used by General Hamilton in conversation at
a meeting of the Society of Cincinnati shortly after the death
of Greene.

opportunity of mental improvement. There also was the bookbinder KNOX, and from among the mechanics of New-York came forth our WILLET,* "the bravest of the brave."

Abroad, our interests were watched over, and our national dignity represented by the printer FRANKLIN, who, amid the varied avocations of a busy life, had made himself one of the most accomplished men of the times, and, after attaining the highest honours of scientific fame, in his venerable and illustrious old age brought all that learning, science, and fame to the service of liberty.

Foremost in our councils at home, and enrolled among the immortal names of the committee of five who prepared and reported the Declaration of Independence, was the shoemaker, ROGER SHERMAN, a man self-educated and self-raised. He was one who by intellect and knowledge commanded the confidence of the wise and swayed the opinions of the multitude, for he had not the gifts of external show, or "the loud and rattling tongue of saucy and audacious eloquence." As an eloquent colleague of his in the Senate and on the bench† once described him to be, "he was a slow-spoken and almost tongue-tied man, but his head was as clear as light."

There were other names like these which I cannot now pause to recapitulate. Our more recent history is also full of instances of the most honourable offices of society honourably discharged by men who had enjoyed no higher early advantages than

* Colonel Marinus Willet, afterward Mayor of New-York.

† The late William S. Johnson of Connecticut.

those I have named, but who had used well what they did enjoy.

But I fear to speak of the occurrences or the men of our own days, lest I should seem to play the flatterer. Still I cannot forbear from paying a passing tribute to the memory of a townsman and a friend. It is but a few days ago that the wealth, talent, and public station of this city were assembled to pay honour to the brave and excellent Commodore Chauncey. Few men could better deserve such honours, either by public service or private worth; but all of us who recollected the events of the struggle for naval superiority on the lakes during the late war with Great Britain, could not help calling to mind that the courage, seamanship, and ability of Chauncey would have been exerted in vain, had they not been seconded by the skill, the enterprise, the science, the power of combination, and the ready and inexhaustible resources of his ship-builder, HENRY ECKFORD.

But, fellow-citizens, I must not detain you any longer. I have but to say, that in the examples I have brought before you, you have the earnest, the pledge, the proof of what is in your power to achieve, of what you owe to yourselves and to your country. The ardour for improvement, the thirst for knowledge manifested by the mechanics of this and others of our cities, are gratifying indeed. As they spring from generous motives, as they overshadow and destroy meaner propensities and poorer desires, they afford of themselves no barren subject of gratification to the patriot, the philosopher, and the philan-

thropist. But they derive a tenfold interest and value from the greater results which they foretell, and the more glorious future they appear to usher in.

Even so the mild and balmy spring, while it gladdens the eye with the young grain, the tender grass, and the white and purple blossoms of the orchard, gives to the mind the cheering promise of the life-sustaining corn, the delicious fruit, and all the riches, the joys, and beauties of serene, bright, and abundant autumn.

THE
INFLUENCE OF MORAL CAUSES
UPON
OPINION, SCIENCE, AND LITERATURE.
BY GULIAN C. VERPLANCK.

"Est intellectus humanus instar speculi inæqualis ad radios rerum, qui suam naturam naturæ rerum immiscet eamque detorquet et inficit"—
"The human mind, like an irregularly-cast mirror, imparts its own character to the forms it reflects, colouring or distorting them according to its own nature."—BACON.

THE
INFLUENCE OF MORAL CAUSES
UPON
OPINION, SCIENCE, AND LITERATURE.

IN an academic address delivered at the annual celebration of the literary societies of one of the colleges of my native state of New-York, and which has since been published, I endeavoured to call the attention of my young hearers to the consideration of those moral uses and influences that ought rightly to flow from their recent studies and acquirements.* The business of the scholar was, I urged, the study of truth : of truth, either necessary, as in mathematical, and, to some extent, in moral speculation ; or else universal or general, as in the investigation of nature, and the analysis and classification of the complex phenomena presented to our senses. Truth, too, in another sense—the truth of human nature, is the source of all literary influence, and grace, and interest ; for it is the reality or the faithful echo of human feeling alone that can awaken and keep alive human sympathy ; and without these, literary fame and influence must be but local and ephemeral.

* Discourse delivered after the Commencement of Geneva College, 1833.

But the natural and legitimate tendency of the knowledge and feeling of all sorts of truth, though capable of abuse and perversion, must be—cannot but be—in unison with sound morals. The enlightened understanding gives light to the conscience; the genius, once fired by the contemplation of man's duties and powers and of his Maker's wisdom, will warm the affections and heart. Any other result—and quite other results are but too frequent—is the deliberate and wicked perversion of Heaven's best gifts intrusted to the discretion of man, and a violation of the declared design of their Author legibly inscribed upon them. The gifts of science and learning bear upon them the evidence that they were designed for the diffusion of happiness, and for the elevation of the human race in the scale of universal being. They were confided to man that he might be the instrument of beneficence towards his race. The pervading fact that the results of science and the accumulations of knowledge are far beyond the means of any single and unaided intellect to work out for itself, reads to the scholar the silent but impressive lesson, that, as he owes these treasures to the conjoint labours of many others, so it is also for the good of others that he is bound to employ them.

The difficulties and doubts that overcloud our best knowledge, show us our weakness and teach man humility, while the grandeur of the Creator's works and laws places in the strongest light, by the contrast, the littleness of all human pride, the falseness of the glories, and the insignificance of the vexations of life. The discipline of the mind in the search for

scientific truth habituates the student to the consideration of leading principles on all subjects, and can thus emancipate him (unless he make himself a voluntary slave) from the control of mere authority, of interest, of habit, or of passion, in the formation of those opinions which are to be the guides of intelligent action in life. Thus may he be enabled to preserve for himself a consistency of character and thought, above the fluctuations and continual self-contradictions of sects and parties, above the temptations of personal interests, above the weakness and caprices of passion and pride, of base fear or low desire. Taught to strive for the dominion of truth and not for the victory of party, he will find, in that reverence for truth as an ultimate end, a sure antidote to the bitter poison of intolerance. Thus, the larger and the clearer his views of creation and its mighty laws, of man and his mysterious powers, duties, and destinies, the more distinct ought naturally to become his perception of moral accountability; the greater, too, may be his freedom from the thralldom of sense, and the nobler his capacity for beneficent action.

But, while such are the right and natural, they are, unhappily, by no means the necessary influences of these rich gifts and glorious privileges. Mathematical and physical science may but furnish arms to tyranny, or, worse than that, forge the weapons of sophistry against the dearest consolations and hopes of man. The imagination, cultivated by taste, enriched by learning, may become—as it, indeed, has too often actually become!—incorporate with and

subservient to the poorest lusts ; so that, like the foul sorceress described by Milton as keeping hell's adamantine gates, while it rears its godly front towards the skies, beaming with seductive beauty, it at the same time winds its poisonous length in many a scaly fold far along upon the earth ;

“ A serpent armed
With mortal sting.”

Such is the dread responsibility accompanying the gifts of talent and knowledge—such their benign, natural use—such and so dire their effect when abused.

With topics and arguments like these, I endeavoured to impress upon the young and ardent minds whom I then addressed the conviction that knowledge was not merely power, but that it ought to be, and might be, virtue. It was a grand and fertile subject, to which the best powers of reasoning and eloquence would have scarcely been able to do justice within the narrow limits of a single academic discourse. In tracing therefore, imperfectly (as it could not but be), the mutual connexion of intellectual improvement and acquirement, with the moral disposition, temper, and principles of conduct, I was compelled to restrict myself to a part only of my subject. I spoke but of the right and proper influence of mental cultivation upon moral improvement, leaving aside all consideration of that reciprocal action whereby sound morals, benevolent desires, and holy aspirations can purify and exalt the intellect, so that while the mental sight is cleansed from that

film which darkens its perception of moral right, it also acquires a keener and truer vision for all the objects even of natural or political science, for everything that concerns the wants, interests, happiness, and power of social beings.

It is to the consideration of some hasty views upon this subject that I have devoted the present essay. It is a theme especially deserving the serious attention of the young student, since it is to him, and such as him, fresh from the pursuits of science and the study of the great works of ancient genius, and animated with the still thrilling sense of the glories and excellence of learning, that our country must chiefly look hereafter for the formation of its most important opinions, and the creation and diffusion of that literature which gives to a nation its form and character, and sways its future destinies.

In every walk of scientific research, the student is struck with one grand and controlling principle. He sees throughout the whole one vast harmony and correspondence of all the laws of the Creator's action and government. Myriads of insulated facts, collected by observation, group themselves together under general resemblances of kind, and are resolved into universal laws. The comparison of these more general expressions of physical knowledge with each other, and with the necessary truths of number and figure, lead to still more striking views of the unity and correspondence of all and each of them. All the discoveries of science constantly lead on their own simplification, because they unveil more and more the operations of one All-wise mind pro-

ducing the grandest and most varied results by the fewest and simplest principles and rules of existence and of power.

To the earlier astronomers, the phenomena of the heavens presented a thousand dissimilar appearances, until their map of the skies was "with cycles and epicycles scribbled o'er," in the vain effort to reduce to rule the motions of the planetary bodies by bold conjecture. But the progress of science, while it has multiplied the facts of observation a thousand fold, has resolved them all into the simple and sublime operation of the one great principle of gravitation, pervading all known creation, connecting alike the most distant periods of duration and the most remote regions of space under one common law; and, while explaining the movements of whole systems of suns and revolving planets, reducing their orbits to the government of the same rule which regulates the falling of heavy bodies and the swinging of the pendulum upon our little earth. Nor is this admirable and beautiful harmony by any means limited to material nature. The moral nature of man is suited to his physical condition, and harmonizes with it in exquisite adaptation. Those philosophical thinkers and reasoners, who, from the days of the wise son of Sirach to the humble and sagacious Butler, guiding their cautious steps by the slender and delicate thread of analogy, have been led onward, from the facts of the natural world to the vindication of the "ways of God to man," have testified how the constitution of nature, as it appears in all that surrounds us, answers to and gives evidence of that

far higher and more lasting constitution of God's moral government of his intelligent beings, so that "all things are double, one against another." It is in conformity with this comprehensive harmony that the Creator seems to have ordained a like connexion between Truth and Goodness ; so that, as Truth is the natural teacher of Goodness, Goodness is again the surest guide to Truth. This is no arbitrary appointment of the Supreme Ruler, without any other reason than his good pleasure. Like all the other arrangements and ordinances of Almighty Wisdom within the comprehension of man, it appears to be the result of design ; the Creator choosing to obtain his mighty ends, not by the simple exertion of power, but by the use and combination of fitting means. For, look at the operations of our own minds. When are they best fitted for the investigation of truth, for the study of wisdom, for the right contemplation of excellence ? Not surely when they are excited by the fevered gayety of pleasure, when they are kindled by wrath, fretted and irritated by envy and resentment, or swollen by pride ; or when the desire of wealth or the lust of power has taken possession of the soul, and lords it, without a rival, over its faculties. Such causes of excitement may, each and all of them, give strength and intensity to the mind's efforts for the attainment of any of its favourite objects, or even for the gratification of its lowest desires. But surely, for all great and worthy subjects of pursuit or of contemplation, the intellect is then most vigorous when it is least distracted by passion ; it is clearest when it is

most calm ; brightest when it is most pure. Then is the mind's eye most clear and far-seeing when it can most boldly and steadily fix its gaze upon the fountain of light ; when it does not habitually contract itself to the small objects of time and sense that float before it. Then is the wing of Genius strongest and steadiest when it aims its flight the highest above the fogs and clouds of human passions and desires. Then is practical talent most efficiently, most successfully employed, even though it be in the humblest walks of its exercise, when it labours not to satisfy its own little ambitions, or envies, or jealousies, but when benevolence or duty, when patriotism, or charity, or friendship, guides and animates its energies. If such is the unfailing result as to all moral inquiries and social duties, it is scarcely less so in relation to speculative science, whether physical or intellectual.

There is a dogma taught in some schools of metaphysics, that belief is wholly involuntary ; and that, as opinions must depend entirely upon the reasons presented to the mind's consideration, they can have no moral character, good or evil. If this doctrine be true, it would seem to follow that belief and opinion must be just as independent of all moral influences in their origin and formation, as they are in their issue and character. This is a dogma that, passing from the books and schools of philosophy to the forum and the senate, has furnished argument for the grave review and the popular harangue, and served as the foundation of reasoning and declamation, sometimes in the cause of skeptical indifference,

and sometimes, better employed, in the service of toleration and equal laws. It contains a remarkable mixture of truth and error, and the limits of each are indicated and well defined by the purposes to which the doctrine has been applied, and by the consequences deduced from it. As applied to enforce a liberal and just tolerance of sentiment towards difference of faith or opinion, it points out correctly the numerous sources of innocent error, from some one or other of which no mind can be wholly exempt. There are the errors of involuntary ignorance. There are those springing from ideas early instilled by education, and strengthened by youthful associations—unfounded, unexamined, it may probably be—unsuspected, but yet inwrought deeply into our dearest sympathies and best affections; there are errors from erroneous information, and facts believed on authority respectable in itself, or venerable in our eyes from gratitude or love, from custom or prejudice; errors, again, arising from the peculiar personal character of the individual, his turn of thought, his capacity for reasoning, his desires, appetites, habits, his very physical constitution and circumstances in life. Thus it may often happen, that the mixture and association of the best sentiments and the most essential truths with baser materials are often as real and as excusable causes of error as perfectly involuntary ignorance. Involuntary ignorance, moreover, in a being so limited as individual man, while the collective knowledge and the pressing duties of his species are so vast, is by no means confined to the least informed portions of society. It may be found where

it is least suspected, and often in company with large acquisitions in other respects. As, then, correct deductions can be drawn only from the facts and arguments actually comprehended by the mind, error may thus be pardonable, be innocent, be virtuous. In the honest language of the sternest and most uncompromising of modern controversialists,* "though truth can be but on one side, sincerity may be on both." Such is the lesson of tolerance for his fellows that the contemplation of man's weakness and fallibility ought to teach him. But a closer inspection of our own minds and hearts will show us yet other principles at work in the formation of opinion, always operating upon such opinions as are connected with the conduct and business of life, or the regulation of the heart and the desires—often affecting the speculative reason, and sometimes even the observations and conclusions of physical philosophy. The mind has a strange capacity of deceiving itself, as to what is or is not the just inference of the evidence within its reach. It can wilfully turn away altogether from the most important considerations, or pass them over with a slight and careless glance. It can fasten its whole or its chief attention upon some single point favourable to its own preconceived notions, to the party it has espoused, to its accidental loves, or hates, or caprices. It can deceive itself by resting implicitly upon some single, strong, and easily comprehended argument on the one side, while it impatiently turns away from the far stronger opposing demonstration that results from a numer-

* Horsley.

ous and complicated, but united authority of facts and reasons. It can view things, not as they appear in the clear, colourless ray of reason, but as they show discoloured by interest, prejudice, or ridicule, according as the fashion of the world throws upon them the many-changing colours of its ever-turning prism. It can acquiesce in the first plausible conclusions that may coincide with the interests or the fancies of the individual, and resolve to think no farther. It can obstinately shrink back from the painful task of unsettling early opinions, and plucking up maxims and doctrines that have been implanted early, and have entwined their roots with every fibre. The prejudiced individual may (to borrow the Baconian imagery) obstinately refuse to look forth into the broad daylight, and perversely form his judgment of all things from those dim shadows that flit across the darkened cavern of his intellect, where he has erected the shrine of the idol of his secret worship, upon whose altars sometimes truth and sometimes virtue is the sacrifice. Facts may be assumed upon authority, without investigation, because we wish them to be true, and would rather take them as such than undergo the labour of examination, with the hazard of enduring the mortification of finding them refuted. Nay, more, experience has a thousand times shown, what otherwise would seem incredible, that when the strongest and clearest evidence has been forced upon the mind, its power can be completely deadened and resisted by mere habit or pure mental indolence. Above all, words, mere words, may be taken without ever

weighing their real meaning, or considering whether they have any meaning at all, and pass so current for realities, that thus a man may go through life in the loud and fervent profession of doctrines or facts, without the slightest suspicion that he is utterly ignorant of what those facts or doctrines may be—without realizing them in any actual application to nature or life, and, it may be, in the daily contradiction of his personal conduct to the words constantly upon his tongue. Thus it is, in another view of the question, that error may be very far from guiltless ; that the moral faculties have much to do in the formation of opinion and the discovery of truth. From all this it follows, that the true philosophy of the laws of belief, on the one hand, bids us beware of too hasty and confident a reliance on our own judgment, and, still more, of rash scorn for the minds or hatred for the persons of those who range themselves under opposing banners to our own on the great questions which divide society ; while, on the other side, it teaches us no less imperatively that we are morally accountable for the right operations of our intellect, and the proper use of the means of ascertaining truth placed within our reach.

Foremost in the list of those virtues which are to be cultivated, not only for their own sake, but because they give energy to intellect, and diffuse light and heat through every region of man's speculative reason and practical understanding, is the Love of Truth. It was well said by the most sagacious and acute, and yet the most humble, patient, and cautious reasoner of the last age (Bishop Butler), that

the great intellectual vice of the readers and students of modern times is, that their "desire is not to know what is true so much as what has been said on any subject:" in other language, they wish to acquire knowledge rather than wisdom, words rather than principles, to become able to talk learnedly rather than to judge wisely.

The naked desire of knowledge may be considered as a mere instinct of our nature; a rational instinct, when it covets objects of inquiry fitted to engage our reason. But this becomes mere idle curiosity when it turns wholly to petty objects and trifling inquiries; the solace of indolence, that dreads vacuity but fears labour. This natural propensity only, then, assumes the character of virtue when it becomes the desire of gaining knowledge and possessing truth solely for their own sakes, as objects and ends worthy the pursuit, and fitting the capacities of an immortal mind; or, if viewed as means at all, only as the means of effecting greater good to man, or of more worthily serving the Giver of all wisdom. Then is this desire most truly a virtue when it is most pure from the mixture of all other and personal motives; when the knowledge to be gained and the talent won are not looked for to serve as the food of vanity or the instruments of ambition, to aid in satisfying the craving for notoriety or the lust of power. Would you know what is the effect of such mixed motives upon science? Look back upon its history. Take, for instance, those parts of physical science where one would think moral motives could least operate. Antiquity might boast of

minds as acute, as daring, as inquisitive, as comprehensive, as patient of labour, as eager for glory, as any that have adorned later times. Why, then, did these great men, the doctors of the portico or the academy, or those earlier Eastern sages from whom they acquired their first lights, or the no less laborious and subtle disputants of the middle ages, to whom they handed down their vain and empty wisdom—why were all these so long bewildered in the maze of words? It was simply because they sought not so much truth itself as glory to themselves—not the knowledge of what is, but the victory of their party and the fame of its leaders. These self-styled lovers of wisdom, instead of being humble seekers for truth, were the ambitious heads of literary factions, struggling for popular favour, and anxious to gain fame by dazzling novelty of hypothesis, by ingenious conjecture, by eloquent declamation, or by acute and perplexing verbal subtilty of argument. They were proud to baffle their opponents by sophism, not ashamed to overwhelm them by dogmatical denunciation. Hence, for century after century, while art advanced slowly, and but slowly, as it must ever do when unaided by reasoning from the more general laws of nature governing its particular applications—all that called itself science was a jargon of words, or, at best, a system of plausible conjectures. I need not tell you how all this was dispersed into thin air by the philosophy of Bacon, indicating those laws of laws that guide to the right study of nature, and, still more, by the successful practical application of his speculative philosophy by Newton

and his followers. What is most to our present purpose in the history of that great philosophical revolution is, that it was mainly a reformation in the *moral* character of physical investigation. It is in the greatest simplicity of spirit with which truth has been sought—in the comparative rejection of party spirit and pride of opinion—in the frank confession of the imperfections of our actual knowledge—in the increasing conviction of the inability of our limited minds to comprehend all the multiplied relations of the works of infinite wisdom and power—in the consequent lowly accuracy of observation and conscientious honesty of statement—in the willingness to surrender the pride of fancied knowledge whenever new and surer light opened upon the inquirer—in all these moral causes, far more than in the most profound wisdom of Bacon, the most patient investigation, the grandest and broadest inductions of Newton, or the most sagacious and delicate analysis of the chymists of our own age, do we behold the chief fountains of those floods of science which now pour themselves forth on every side, to fertilize and gladden the world. Or rather let us say, that in Bacon's profound speculation—in the grand, experimental, and inductive investigations of Newton—in the sagacious and powerful analysis of Davy or Berzelius, we see but the natural workings, the products and fruits of these moral causes. These have made physical philosophy to lay aside its proud effort to reason out what must be and what ought to be, and to content itself with the diligent and faithful search of the knowledge of what *is*.

The founders of preceding systems, from Thales to Descartes, framed their ingenious and hasty theories in the proud confidence of genius, as the monuments of their own glory. Their doctrines came complete and perfect from the minds of these sagacious and inventive authors; they were comprehended at once by their disciples; they had their day of fame, until the next great accession to human knowledge presented facts utterly in contradiction to their hypotheses, and they crumbled at once into dust. Newton considered himself but as the lowly interpreter of nature, whose language he professed to understand darkly, and only in part. Hence his philosophy passes not away; but, susceptible of continual development and improvement, can now explain facts utterly unknown to its founder; and every new achievement of physical investigation or of mathematical genius, instead of overthrowing or shaking its solidity, but tends to its enlargement and perfection.

Still let us not be too loud and bold in our exultation. Let us not too complacently contrast our superiority in that moral wisdom whence sound knowledge springs with the faults and errors of our ancestors.

“The ascending day-star with a bolder eye
 Hath lit each dewdrop on our trimmer lawn!
 Yet not for this, if wise, will we decry
 The spots and struggles of the timid dawn,
 Lest so we tempt the approaching noon to scorn
 The mists and painted vapours of our morn.”*

A purer religion has beamed upon us, giving light

* Coleridge.

by its very reflection, even to those who turn away their eyes and hide their faces from its direct rays. A thousand foul and monstrous forms of error, that roamed like hideous spectres through the darkness of former ages, have been put to flight. Men have learned to know and to assert the rights of private conscience ; and habitual freedom of inquiry and discussion has taught them to raise their eyes from the ground, and to look boldly in the face of every claim upon their faith or credulity.

Yet, with all these advantages, this comparative freedom from the dominion of external influences, the encouragement of so many and such brilliant examples of devotion to scientific truth, and of glorious success in its pursuit, the blaze of light surrounding us, the exciting atmosphere of free inquiry and bold discussion that we hourly breathe, this magnificent accumulation of knowledge enriching the general mind, the power it has given us over nature, and the increased vigour our intellects may draw from it for farther and nobler conquests ; in spite of all these, the present generation has still to blush for many of the selfsame impediments to the study of truth under which our predecessors laboured : with them, indeed, the misfortunes of their times and circumstances ; with us, wilful and self-imposed.

“ People complain of false theories,” was the remark of a distinguished medical teacher ; “ save me from false facts.” It has, for instance, unfortunately been the opprobrium of medical science, and some of its collateral branches, that scarcely any great question can arise, involving the nature and

operation of those wide-wasting diseases which sweep myriads of our race to the tomb, without the professors of the healing art being split into parties—I might almost call them factions—contending with all the indiscriminate zeal of rival politicians. In the intemperate heat of controversy, how often has it happened that the main facts of a medical discussion of vital interest are seen or related only through the medium of a favourite theory, and thus for every useful purpose perverted, falsified, or suppressed. Thus, in one of the most beneficent of human occupations, the spirit of party, and sometimes, too, the meaner excitement of personal dislike, or envy, or professional rivalry, is suffered to overshadow and darken the most important and perhaps the most obvious truths. I do not select the quarrels of physicians for special censure. Various circumstances of my life have brought me much in contact with that profession. I am no scoffer at medicine. The more I have seen of the profession, and especially of the application of their skill, on the great scale of hospitals and other public institutions, exhibiting there “the power of art without the show,” the more has their art gained on my confidence, their knowledge on my respect, and their personal character on my esteem. It is on these very accounts that the occasional supremacy of inferior and worldly motives over the simple love of truth, on such subjects and among such men, is the more to be lamented.

“Who would not smile if such a man there be?
Who would not mourn if Atticus were he?”

But theirs is no singular pre-eminence in this melancholy subjection of the reason to the inferior active faculties and the consequent perversion of its most important conclusions. Why is it that doubt and darkness still seem to hang around so many of the great truths of political science, of moral government, of political faith? Much of this doubt we must unquestionably allow to arise from the nature of the subjects themselves, and much from that of our own minds, too dwarfish to grasp the things which partake of infinity and eternity—too dim-sighted to trace the deep and intricate windings of our own spirits and hearts. But how much, also, from the evil passions and the worldly interests that intrude themselves unbidden into all moral inquiry, nor fear to tread with unhallowed feet in the very sanctuary of the Most High?

Among the views of futurity described by Milton as having been exhibited from the “specular mount” to the cleansed and open eyes of our first parents, is that of the temptation and fall of that grave race of men, whose lives

“Religious, titled them the sons of God ;

* * * * *

Just men who seem'd, and all their study bent
To worship God aright, and know his works,
Not hid.”

Just men and grave as they were, yet they are beguiled by the blandishments and inflamed by the charms of the beauteous offspring of the tents of wickedness, and ignobly yield up to them “all their virtue, all their fame !” This seems to me no un-

apt symbol of the effect of those intellectual blandishments and desires, that beguile and lead astray the learned and the wise, the student and the professed teacher of truth, in their most serious studies ; that can inflame with the spirit of party and the rage of fanaticism even the peaceful study of the learning and languages of antiquity, as bearing upon the interpretation and exposition of Scripture. Alas ! for “ the iniquities of our holy things.” Let it suffice to have thus indicated what I could not pass by in silence, nor yet dwell upon without the hazard of useless offence, or the touching upon topics foreign to my present design. To trace out accurately the working of these mental maladies in reference to the intellectual processes and conclusions of the theologian, demands a deeper and more familiar insight into the morbid anatomy of mind, and a steadier and bolder hand in the dissection, than I can flatter myself to possess.

The influence of the same or similar passions and dispositions, in thwarting or misdirecting the energies of the mind, and producing the worst evils of false knowledge where true knowledge is most bounteous of its fruit for the public good, may be observed with still greater distinctness in the doctrine of politics and political economy, of rational jurisprudence and of civil administration. The meager outlines of those doctrines, as they are taught in the text-book and the lecture-room, may be clear, consistent, and undisputed ; but once reduce them to practice, and how does that appearance of certainty vanish away ! What contradictions about matters of fact ! what

collision of argument ! How little of any principle received with real and confessed authority by all sides and at all times ! What single doctrine is to be found, the reception or denial of which may not be made the universal creed of opposing parties, each, in turn, maintaining or denying, as such profession may give countenance to a favourite measure or suit the policy of a favourite leader ? Nevertheless, every part of the theory of civil polity, varied as it may occasionally be by circumstances of expediency in its application, must be susceptible of the highest moral certainty, since the whole is founded on general and unvarying laws of human nature, more complicated, but little less regular than those of physical being. Oh, if the desire of truth, as the means of public good, alone animated and governed all political controversy, how soon would these apparent disagreements vanish, these contradictory assertions and jarring arguments dwindle in appearance into what they are in reality, either verbal differences, or partial, and, therefore, imperfect views of the same broad principle. Men must doubtless always differ in their judgment of the expediency of measures, for they must still be short-sighted as to the present and blind as to the future. They will always have passions, and must, therefore, always be subject to occasional delusion from the arts of the flatterer and the demagogue ; and they may too often, in moments of excited feeling, follow and shout in the train of an unworthy favourite. But let any great truth, involving, at all times and under all circumstances, the good of the whole or the happiness

and liberty of many, be once firmly settled and understood, as well as confessed in words by all, and then you have erected a great landmark to prevent the encroachments of fraud or force upon private rights or the public weal. Such admitted principles become the citadels of refuge, where the champions of truth and freedom, if at any time borne down by the overwhelming throng of faction, or scattered and divided from each other by feuds, jealousies, and accidents, may meet and rally together, and, raising high the banner of acknowledged, and venerated, and long-cherished principle, call the people to the rescue of their rights. In exact proportion to the honesty and fairness with which the wise and eloquent have been accustomed to expound, and the people to hold and cherish such principles, is the strength and the might of the returning surge, sweeping before it alike the devices of the crafty and the power of the tyrant. But, alas for the people among whom such doctrines and principles are but the changing pass-words and countersigns of political warfare ! Long must they suffer whatever ills the artful or the ignorant leader may inflict upon them, in his march onward towards the prize of ambition.

The implicit devotion to truth is not only a positive virtue in itself, but it includes or implies many others. It implies, of course, if not an entire exemption from the malignant, envious, and selfish vices, at least the power of perceiving them in our own breasts, and of bringing them into subjection to reason and conscience whenever they impede the right exercise of the judgment. It implies, also, the

possession and practice of several distinct and positive virtues. That patience of labour and endurance of disappointment, such as, in the active concerns of life, preserve the even balance of the faculties, fit them to all the duties of society, and bear the possessor steadily over the tossing billows of adversity, are also the great secret of scientific acquirement and discovery. It was in this alone that the meek-spirited Newton felt and confessed his superiority to common men. It was this unpretending virtue that gave energy and success to his unrivalled mathematical sagacity, and that combined the gigantic powers of his reason and invention with a laborious and unrivalled accuracy of observation and minuteness of experiment. This virtue may be sometimes the offspring of an enthusiastic love of knowledge ; but it is then most perfect and most beautiful when it grows up, side by side, and from the same root, with its twin virtue of Humility. The impatience of long-sustained attention, the avidity for plausible hypothesis, the disregard for facts that militate against favourite theories, are all of them the natural fruits of proud self-confidence. It is this inflated vanity that so often induces the moral or political reasoner to rear his theory upon so slight a foundation of reality, and, when it is once reared, to repose so complacently upon his fancied laurels, or to rouse himself from his flattering dreams only to heap scorn and obloquy upon the heads of those who oppose or who doubt. On the contrary, it is the deep-felt sense, the familiar and intimate conviction, that man is but darkly and imperfectly wise, while nature is

great and its Creator infinite, that prepare the mind for laborious study and patient inquiry ; for the ready sacrifice of long-cherished notions and of fancied learning ; for the prostration and subjection of the whole man to truth, and to truth alone. But from this very lowliness springs up another and an opposite, yet not contradictory virtue. It is that of manly independence of judgment. For the truth, once found, is acknowledged without a rival, and estimated as above all price. What is it to such a meek but sincere inquirer that the fashion of the world is against him—that grave authority frowns upon him—that old familiar friends denounce his motives, his judgment, or his character ! He has sought for a better good than they or theirs can bestow, and he has gained it. He has laboured to learn that which would make him wiser and better, and others happier. That knowledge has seized upon his intellect and his affections as with a giant's grasp. It has entered into his soul as a beam of living light. There is no place left there for the creeping things of darkness—for fear, for selfishness, for vanity, for false shame. He knows that the fabric of his belief is firm and solid ; for it rests on the deep and low foundation of an humble, and, therefore, a true estimation of himself. Founded as it is on the rock of humility, built up by patient industry, the breath of popular favour or censure passes by it unheeded, and the tempest of persecution beats on it in vain.

It is on this spirit of firm and conscientious reliance upon the cautious and deliberate conclusions of the judgment that Truth and Reason must mainly

depend for their general diffusion and reception. It unfortunately happens, that in many parts of human knowledge, and more especially in those involving moral or political considerations or consequences, that interests and prejudices, as well as strong habits, are commonly identified with the received opinions of the day, whatever they may be. Mental indolence, long contented to doze over its present notions, is offended when the torch of discovery flashes upon its slumbers. Pedantry is indignant at beholding all its fancied wealth swept away as mere rubbish by the bold teacher of newer and better knowledge. Ancient and time-honoured authority sees with alarm its influence shaken and its decisions appealed from. The civil power, in some times and countries—in our own much more frequently—the popular prejudice is called upon to put down the innovator, who has no weapons to use in his own defence but those of argument and evidence. Unless, therefore, the hapless teacher of unpalatable novelty can find, in the minds of the well-informed portion of society, not only candour of judgment, but independence in asserting and maintaining that judgment, his arguments and evidence must lie smothered, for year after year, till the advance of improvement prepares another generation to receive with joy what their fathers rejected—not from ignorance, but from mental timidity.

There is another view of this subject which strikes me as peculiarly important, in regard to our own state of society. It is the consequence of many circumstances in our lot (most of them very happy

ones), that our society is constantly divided into organized parties—and I use the word party in its broadest signification, without limiting or applying it to the mere political parties of the day. Now the certain tendency of the united and concentrated action of parties is to extremes. In their heated furnace, all individuality of thought and sentiment is melted down into one common mass. But the public good generally lies somewhere between the two extremes of either side. The truth, whatever it may be, for which all profess to seek and to contend, most likely embraces many particulars, which may be held partly on each side. It is the manly independence of private judgment alone, boldly exercised and frankly expressed on both sides, that can best check this excess of fanaticism, or bigotry, or faction (as the case may be), and soonest and most safely bring the public mind to its right and equable poise.

It is true, that when free discussion is allowed, the very opposition and counteraction of extremes may prevent much of the practical evil of any speculative opinion held by a sect or a party. Yet, if this result is not obtained by the independence and moderation of the individual members of such sect or party, tempering the violence or moderating the extravagance of those with whom they act, it is the late fruit of sad regrets for mutual error and common injury. Such flames, like the fires that sweep over our forests, may indeed be checked by other flames *counter-burning* in an opposite direction, leaving nothing to prey upon between their meeting fury ; but,

ere their rage is spent, the pride of the forest is humbled, and lies low in black and smouldering ruins.

Nor is the influence of the benevolent affections, that of the strong desire of doing good towards our fellows, that of the sense of public duty, to be overlooked in estimating the advantages that intellectual pursuits may derive from moral rectitude. I am willing to allow that there is, on the whole, too great a tendency in the present age to look only at the direct and immediate utility of our studies and researches, forgetting, or not knowing, that for any truly great form of intellectual production, the love of the pursuit itself, and the conscious delight of innate power in obtaining success, must themselves be ultimate ends, though they may not be the only ones. An eloquent and profound philosopher of our own day, himself one of the most successful of discoverers as well as of practical teachers (Sir John Herschel), has well and indignantly repelled the insult upon the native dignity of speculative science offered by those reasoners who, placing it in the light of a mere appendage to our physical pleasures and conveniences, ask at every turn, "*Cui bono?*"—"to what good do your researches tend?" "This question," says the indignant philosopher, "is one which he who loves knowledge for its own sake, and enjoys, as a rational being should enjoy, the mere contemplation of harmonious and mutually dependant truths, can seldom hear without a sense of humiliation. He feels that there is a lofty and disinterested pleasure in his speculations, which ought to exempt him from any such questionings; com-

municating, as they do, to his own mind the purest happiness (after the exercise of the benevolent and moral feelings) of which human nature is susceptible, and tending to the injury of no one, he might allege this alone as a sufficient and direct reply to those who, having themselves little capacity and less relish for intellectual pursuits, are constantly repeating upon him this inquiry.”*

To this lofty defence, the history of mathematics, of chymistry, of medicine, of mineralogy, has enabled the philosopher to add another ground of justification, of which the merest utilitarian must feel the force. It is this : that speculations, apparently the most unprofitable, are precisely those from whence the most useful applications have emanated.

All this is true. It is not, however, the less true, that the kindling desire of doing good—of bettering the condition of others—of rescuing our species from the ills of disease or of ignorance under which it suffers, is a most effective and sustaining stimulus to the mind, the best preservative from its directing its energies to paltry objects, the surest antidote to vanity, selfishness, and whatever evil passions may intrude themselves into the study, and flit before the eyes of the contemplative sage, clouding his vision of the great, the distant, or the infinite. It prevents him, moreover, from suffering his contemplations to evaporate in ideal generalities, and prompts him to give them greater accuracy, as well as surer certainty, by bringing them to the test of reality, as applied to human uses and wants. It often adds

* Herschel's Discourse on the Study of Natural Philosophy.

largely to the treasures of pure science, by first exciting the man of thought to transfer the truths of abstract reasoning or of curious investigation to the daily uses and wants of life, and then, in that very application, furnishing him evidence, illustration, and experience, reflecting back new lights upon his previous theoretic wisdom, and so guiding him onward to farther and surer conclusions. The earnest desire of benevolent service to mankind may not only prompt the mind to exertion, but can also lead it to the noblest results. In all the arrangements of nature, physical or spiritual, a vast, far-reaching, and comprehensive benevolence is seen to preside, having in all its numerous and complicated laws and phenomena most excellent and beneficent ends. The philosopher or the scholar, who, cherishing a reverent but confiding reliance upon his Creator's beneficent designs, is warmed with the desire of benefiting his race by gaining for them a better knowledge of nature or of themselves, will often find—has often found—in the undefined anticipations of his benevolence, the sure indications of glorious truths or the means of admirable discovery—truths and discoveries to which he could never have been led by mere cold reason.

So, too, in regard to the creations of Art, of Taste, and of literary Talent. The simple desire of doing good cannot inspire genius; but, in watching over and directing its efforts, in silently excluding from its productions all that is gross in sense or bad in feeling, in suggesting ideas of benevolent tendency, and in communicating to the mind's action the

healthy glow of kindly sentiment or of philanthropic ardour, it insensibly gives to its works a dignity, an elevation, and a power of expression, such as art, or taste, or learning, or even genius alone could never have attained, raising them to a higher stage of mental excellence, and clothing them with the loveliness and the glory of moral beauty.

Above all, such a desire of benevolent utility compels the student to reveal to others the latent treasures of his own intellect, and so secures him from that frequent bane of the meditative mind, the tendency to suffer his philosophy and his invention, his logical acuteness, his capacity for comprehension and generalization, to remain the hidden, and hoarded, and, perhaps, uncounted and unarranged treasures of his interior being, to whose delicious recesses he retires from the cares and duties of society, content to find his employment, his solace, and his joys (like the visionary recluse portrayed by the vigorous pencil of Johnson) in the invisible riot of the mind, the secret prodigality of being "secure from detection and careless of reproach."*

It has happened that the current of my thoughts has led me (somewhat contrary to my first intention) to keep chiefly in view the influence of moral causes, either upon the understanding as engaged in ascertaining the facts and laws of external nature, or else upon the speculative and the practical reason exerted in their respective spheres of meditation upon truth or duty, leaving almost untouched the effects of such causes upon the genius and the works of pure liter

* Rambler.

ature. Little space as I have left to myself to dwell on this topic, I cannot wholly pass over all consideration of that world of imagination, invention, taste, criticism, history, wit, pleasantry, and observation of life and manners contained in the compass of a nation's literature. It forms the very atmosphere of our social life; it acts upon society imperceptibly but continually, and in proportion as the life-giving or the destructive principles predominate in its constitution, braces the frame with health, or secretly instils disease and death into the system. To bear a fitting part in the great social and moral reform which philanthropy eagerly anticipates and benevolence labours to hasten on, the literary man must purify his own heart, and consecrate his talent as a holy gift. For though he aspires not to handle sacred things, yet in the recreation his productions afford to leisure—in the entertainment and instruction he provides for youth and for ignorance, he is indirectly acting upon the well-being of nations, and tinging with good or evil the immortal destinies of whole generations. Let us not imagine that it is easy to conform in this respect to the popular requirements by a simple effort of volition. To write or think with effect to great and good issues, the moral improvement must begin within.

In one of the minor poems of Wordsworth, he describes the long-lost Earl of Clifford, who had been from his childhood estranged from his ancestral halls and castles, and had wandered for years as a shepherd-boy, at length restored to his hereditary honours, and greeted at the stately feast by the fam-

ily minstrel with fervid strains, such as his steel-clad forefathers had loved to hear. The bard paints in glowing strains the ancient glories of the Cliffords, won in many a bloody battle-field by the side of the Richard, and the Edwards, and the fifth Harry of England, until he sees in fancy the scholar-shepherd, who now fills their baronial seat, throwing aside his books, and rushing forth to add new honours to the ancient escutcheon of his house.

“ Armour, rustling on the walls,
On the blood of Clifford calls.
Quell the Scot, exclaims the lance ;
Bear me to the heart of France,
Is the longing of the shield.
Tell thy name, thou trembling field,
Field of death, where’er thou be,
Groan thou with our victory !
Happy day and mighty hour,
When our shepherd, with his power,
Mail’d and horsed, with lance and sword,
To his ancestors restored,
Like a reappearing star,
Like a glory from afar,
First shall head the flock of war !”

What is the effect of this stormy invocation ?
With equal philosophy and beauty, the poet adds :

“ Alas ! the fervent harper did not know
That for a tranquil soul the lay was framed,
Who, long compelled in humble walks to go,
Was soften’d into feeling, soothed, and tamed.
Love had he found in huts where poor men lay ;
His daily teachers had been woods and rills ;
The silence that is in the starry sky,
The sleep that is among the lonely hills.”

There was not, there could not be, any sympathy between the fiery and warlike minstrel and his mild lord. The bard could have no access to the heart

of his hearer. To gain that access, it was necessary that he should have reformed his own desires, tempers, and habits ; his ambition or admiration must have been raised to purer and better things than the feats of warlike violence ; he must have taught himself a truer estimate of the value of glory and of the right materials of happiness. Even so must it be with the author who aspires to obtain and hold any permanent place in the affections of a better age hereafter, or who seeks to find audience among the good and wise of the present time. Even so must it be with him, unless he is content to waste his talent for an ephemeral popularity, or desires, with perverse malignity, to clog the advancing chariot-wheels of Truth and Virtue, thus retarding their victorious march, and delaying for a few brief hours the glories of their triumph.

But it may be objected that I speak now of the benign tendency of well-directed literary talent, which no one denies. But what is the probable effect of such moral correction upon the brilliancy and power of the talent itself? Will it not be sobered down into insipid correctness, reduced to a tame though virtuous mediocrity? Will not its daring originality of thought, its gay coruscations of wit, be for ever banished from our literature? There will be no more Voltaires, no more Byrons. Nay, will not all poetry lose its high, romantic charm, its chivalrous grace, and all the intense interest it obtained from the portraiture of energetic and tumultuous passion? Shall we not then be forced to yawn over the weary realities of life, until we sigh

for the return of ancient genius, with all its ills ? To apply the language of a lamented friend,* the scholar will exclaim,

“ Ye pastoral scenes by fancy wrought,
Ye pageants of the loftier thought ;
Creation’s proud ! majestic things,
Heroes, and demigods, and kings !
Return, with all of shepherd’s lore,
Or old Romance that pleased before.

Ye forms that are not of the earth,
Of grace, of valour, and of worth ;
Ye bright abstractions, by the thought,
Like the great master’s pictures, wrought
To the ideal’s shadowy mien,
From beauties fancied, dreamed, or seen !

Ye speaking sounds, that poet’s ear
Alone, in nature’s voice, can hear ;
Thou full conception, vast and wide,
Hour of the lonely minstrel’s pride ;
As when projection gave, of old,
Alchymy’s visionary gold !

Return, return !”

I see no sufficient reason for such lament or such fears. The passions of men, and the mighty energies they can excite, are not the less capable, either of affording instruction, or of seizing upon the attention, and engaging the feelings, because they are viewed and exhibited by the poet, the moralist, or the historian, from a loftier point of view and through a purer medium. The materials to be used by genius—the “ beauties, fancied, dreamed, or seen,” will remain the same ; but how much nobler the work, when its rules of taste are drawn “ from the upright heart and pure ;” when

* Robert C. Sands.

“The full conception, vast and wide,
Hour of the lonely minstrel’s pride,”

comes with an inspiration, not of an earth-born muse, but given and governed by the heaven-descended Urania, the sister and companion of heavenly Wisdom. What is our own experience on the subject? In the fictions of epic poetry, what is the degree of interest called forth by the cold-blooded and perfidious Æneas, or any of the butchering heroes who have followed him—like his own unvarying “brave Gyas and brave Cloanthus;” all formed alike by the herd of imitators, on the model of pagan heroism, when compared with Tasso’s touching and pathetic adumbration of his own character, in the religious soldier, the faithful lover, the true friend, the brave, the modest, the melancholy Tancred?

Again, in a lighter range of literature. The young adventurers, the gipsies, the pedants, and the villains, are the same beings in Scott and in Fielding. But how different is their aspect and hue as painted by the manly, moral sagacity of the one, and the profligate and sarcastic cynicism of the other! In which, I ask, is the power of genius more conspicuous?

But this is not all. Critics have asserted, and, I think, very justly, that the age of epics is gone by, and the fund of heroic passion and story of the old school quite exhausted. They might add, that so, too, are nearly all the materials whence the “wits of Charles’s days,” and the “men of wit and pleasure about town” (as the phrase then was) during the time of Anne and the Georges, could extract

mirth or amusement. In the fine arts something of the same kind has taken place ; and, in consequence, the most successful artists of our day have thrown aside the tales of licentious mythology and the bloody martyrdoms and extravagances of what may be termed the epic of their art, and sought to give pleasure and gain reputation by portraying the true but gentler features of nature, and the incidents, graces, and affections of domestic life. If, then, in literature, nearly all that phrensied passion or worldly gayety can suggest, has been already said, quite as well as it is likely to be said again, it is from a holier inspiration, a more enlightened morality, a more benevolent sympathy with human weakness and suffering, and a keener admiration of the beautiful and the good, that we are now to hope for the greatest of all literary charms, that of Novelty. If, then, America is to have a literature truly her own, and not the shadow of a shade of European excellence, *here* let her sons seek for originality. Here are the deep springs of thought and feeling, that may gush forth in sparkling rills of native poetry, or well over in broad, brimming floods of eloquence and reason.

THE END.

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